SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 11
JUNE 1, 1970

W70-04045 -- W70-04543

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

AN EXPERIMENTAL STUDY OF THE STRUCTURE, THERMODYNAMICS AND KINETIC BEHAVIOR OF WATER,
Midwest Research Inst., Kansas City, Mo.
Frank T. Greene, Thomas A. Milne, A. E. Vandergrift, and Jacob Beachey.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $0.65. Office Saline Water Research and Development Progress Report No 493, Oct 1969. 60 p, 19 fig, 11 tab, 40 ref. OSW Contract No 14-01-0001-1479.

Descriptors: *Water properties, *Thermodynamic behavior, Analytical techniques, Spectrometers, Free energy, Temperature, Research and development.
Identifiers: *Water cluster formation.

Mass spectrometry and molecular beam sampling techniques were used to obtain information on the thermodynamics and rates of water cluster formations. High and low pressure measurements of cluster formation give apparent concentrations (and free energy of formation) for dimers and trimers as well as an upper limit for the concentration of tetramers. The mole fractions of trimers and tetramers in steam at 1 atmosphere and 373 deg K were calculated. The dimerization rate constant is strongly temperature-dependent and is much less at 300 deg K than three-body collisional frequency factors would indicate. Reverse reactions are quite important in dimer growth. Dimer is formed in appreciable quantities near the end of expansion, in the ill-defined transition region to collisionless flow. More research in this area is recommended. (Carstea-USGS)
W70-04085

PHYSICAL PROPERTIES OF SEA WATER SOLUTIONS: HEAT CAPACITY,
National Engineering Lab., East Kilbride (Scotland).
D. T. Jamieson, J. S. Tudhope, R. Morris, and G. Cartwright.
Desalination, Vol 7, No 1, p 23-30, Nov 1969. 8 p, 4 fig, 3 tab, 7 ref.

Descriptors: *Water properties, *Sea water, *Thermal properties, Thermodynamic behavior, Thermodynamics, Scaling, Desalination, Distillation, Aqueous solutions, Saline water.
Identifiers: Heat capacity (Sea water).

The heat capacity of sea water and its concentrates has been measured in the temperature range 80 deg to 180 deg C using a differential heating method. An equation is given which fits the measured values of heat capacity, together with those from the literature, to within their various experimental accuracies. (Knapp-USGS)
W70-04325

1B. Aqueous Solutions and Suspensions

A NEUTRON SCATTERING STUDY OF WATER AND IONIC SOLUTIONS,
Union Carbide Corp., Tuxedo, N.Y.
G. J. Safford, and P. S. Leung.
Available from Superintendent of Documents, U. S. Government Printing Office, Wash, D C - Price 55 cents per copy. Office of Saline Water Research and Development Progress Report No 485, September 1969. 36 p, 13 fig, 43 ref.

Descriptors: *Neutron absorption, *Aqueous solutions, Frequency analysis, Diffusion, Magnesium compounds, Sodium chloride, Cesium, Ions, Hydration, Kinetics, Analytical techniques.
Identifiers: *Neutron inelastic scattering, Intermolecular frequencies, Ion hydration.

Neutron inelastic scattering was used to study the dependences on concentration, cations, and anions of the intermolecular frequencies and the diffusive kinetics of water molecules in aqueous solutions. The intermolecular frequencies at lower concentrations of magnesium chloride, NaCl and CsCl were nearly identical with those of water. With increasing concentration, new frequencies characteristic of primary hydration complexes appeared and intensified. The frequencies and diffusive parameters of solutions containing small or highly charged cations were primarily determined by the cations and only secondarily affected by monovalent anions. In contrast, a strong dependence on anions in solutions of larger, single-charged cations was observed at intermolecular frequencies and in diffusive kinetics. (Carstea-USGS)
W70-04347

02. WATER CYCLE

2A. General

RUNOFF FROM FOREST AND AGRICULTURAL WATERSHEDS,
Colorado State Univ., Fort Collins. Natural Resources Center.
M. E. Holland.
Available from the Clearinghouse as PB-189 764, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 19 p, 4 tab, 3 fig, 3 ref. OWRR Project A-002-COLO.

Descriptors: *Surface runoff, *Runoff, *Unit hydrograph, *Rainfall-runoff relationships, Forest watersheds, Agricultural watershed.

The dichotomy between forest and agricultural watersheds with areas less than 40 square miles has been studied by looking at the time distribution of runoff from storm rainfall events. The direct investigation of rise times for hydrographs gave inconclusive results, but led to a more fruitful second approach. The second part of the investigation focused on the unit hydrograph as the characteristic response of the watershed. The unit hydrograph can be represented mathematically by two-parameter incomplete gamma function. The rise time for the unit hydrograph is a convenient and significant parameter in determining the shape of the unit hydrograph. The effects of the physiographic parameters of watersheds were removed by determining a hypothetical median watershed and varying the cover characteristics from forest to agricultural. The influences of steeper slopes that are common in forest watersheds were thus eliminated. The results clearly indicate the significant damping that forest cover causes in the watershed response to rainfall.
W70-04055

STOCHASTIC ANALYSIS OF HYDROLOGIC SYSTEMS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ven Te Chow.
Available from the Clearinghouse as PB-189 791, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Illinois Water Resources Center, Research Report No 26, Dec 1969. 34 p, 8 fig, 14 ref. OWRR Project A-029-ILL.

Descriptors: Systems analysis, Stochastic processes, Synthetic hydrology, Water resources develop, Streamflow, Evapotranspiration, Storage, Water yield, Hydrology.
Identifiers: Watershed studies, Precipitation, Hydrologic models.

Hydrologic phenomena are in reality stochastic in nature; that is, their behavior changes with the time in accordance with the law of probability as well as with the sequential relationship between the occurrences of the phenomenon. In order to analyze the hydrologic phenomenon, a mathematic model of the stochastic hydrologic system to simulate the phenomenon must be formulated. In this study, a watershed is treated as the stochastic hydrologic system whose components of precipitation, runoff, storage, and evapotranspiration are simulated as stochastic processes by time series models to be determined by correlograms and spectral analysis. The hydrologic system model is then formulated on the basis of the principle of conservation of mass and composed of the component stochastic processes. To demonstrate the practical application of the method of analysis so developed, the upper Sangamon River basin above Monticello in east central Illinois is used as the sample watershed. The watershed system model so formulated can be employed to generate stochastic streamflows for practical use in the analysis of water resources systems. This is of particular value in the economic planning of water supply and irrigation projects which is concerned with the long-range water yield of the watershed.
W70-04072

STUDY OF THE INTERRELATIONSHIP BETWEEN SURFACE AND UNDERGROUND WATERS IN THE AY RIVER BASIN (RUSSIAN),
Institut po Proektirovaniiu Predpriiatii Nikelevoi Promyshlennosti, Leningrad (USSR).
P. V. Molitvin.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostnykh i Podzemnykh Vod v Karstovynkh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 114-121, 1969. 8 p, 1 fig, 2 tab, 4 ref.

Descriptors: *Surface-groundwater relationships, *Groundwater, *Groundwater movement, *River basins, *Karst, Mountains, Geology, Sinks, Runoff, Discharge (Water), Snowmelt, Rivers, Water loss, Mathematical studies, Mining engineering, Floods, Tracers, Dye releases.
Identifiers: *USSR, Ay River basin.

Hydrological and karstic characteristics of the central watershed of the Ay River and the intercommunication between the surface waters and underground waters were investigated by fluorescent techniques. In carrying out mining operations in the basin, the main water seepage is due to the surface waters of the Kamenka River basin. Atmospheric precipitation over the karstic area will also contribute to the possible flooding of tunnels and shafts. (Gabriel-USGS)
W70-04110

SOME CONSIDERATIONS IN THE ADAPTION OF MARKOV PROCESS THEORY TO RAINFALL-RUNOFF PHENOMENON,
Utah Water Research Lab., Logan.
Jay M. Bagley.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 79, p 633-640, 1967. 8 p, 1 fig, 2 tab, 1 ref.

Descriptors: *Rainfall-runoff relationships, *Streamflow forecasting, *Synthetic hydrology, *Markov processes, Time series analysis, Model studies, Mathematical models, Stochastic processes, Probability.
Identifiers: Watershed models.

The rainfall-runoff process may be characterized by a Markovian stochastic model. The system description utilizes finite time increments of one day for the volumes of precipitation, evapotranspiration, infiltration, soil moisture storage changes, and runoff. The validity of a stationarity assumption (time-independence) for soil moisture storage on a monthly basis was examined and found to be of questionable utility for obtaining runoff probabilities. Equivalent monthly probability distributions were developed which gave considerable improvement and offer promise in providing working tools for purposes of engineering design. The effect

of size of the finite water increment employed in the model is evaluated. Larger increments of water make approximations to the frequency distributions of daily rainfall much more crude. They also give poor approximations to the functions describing processes in the system that change more slowly with time. The study suggests modifications revealed and make the approach more useful. (Knapp-USGS)
W70-04254

A STATISTICAL METHOD TO SEARCH FOR A RAINFALL-RUNOFF RELATIONSHIP,
Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Ingenieria.
A. Capella Vizcaino, and J. L. Sanchez Bribiesca.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 77, p 616-623, 1967. 8 p, 5 fig, 6 ref.

Descriptors: *Rainfall-runoff relationships, *Streamflow forecasting, *Systems analysis, Model studies, Synthetic hydrology, Input-output analysis, Simulation analysis, Mathematical models, Floods.
Identifiers: Hydrologic systems analysis.

Classical methods too often fail to relate rainfall and runoff in basins, when applied to specific cases. The random characteristics of the phenomenon seem to be the main cause. A 'black box' approach, based on Automatic Control techniques is introduced in this paper, as a synthesis system obtained from observed inputs (rainfall) and outputs (runoff). The model can take into consideration rainfall distribution in a basin area, once a weighing function has been established for each input, from a set of orthogonal functions. Changes in the weighing functions are considered, although the great number of parameters involved, and the scarcity of data, introduce limitations to the selected model; besides, it is difficult to attach a reasonable physical interpretation to the results. (Knapp-USGS)
W70-04256

ANALYSIS OF 'BLACK BOX' RELATIONSHIP BETWEEN RAINFALL AND RUNOFF,
Pittsburgh Univ., Pa. Dept. of Civil Engineering.
Chao-Lin Chiu.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 76, p 608-615, 1967. 8 p, 6 ref.
FWPCA Grant 5 T1-WP-41-04.

Descriptors: *Streamflow forecasting, *Rainfall-runoff relationships, *Systems analysis, *Input-output analysis, Simulation analysis, Model studies, Mathematical models, Hydrologic budget, Unit hydrographs, Synthetic hydrology.
Identifiers: Hydrologic systems analysis.

General methods and procedures for determining the rainfall-runoff relationships by the 'black box' analysis are presented. The mathematical technique involves the use of functionals and statistics. Problems concerning the non-linearity and nonstationarity of hydrologic systems are discussed, and possible approaches are presented for solving such problems. (Knapp-USGS)
W70-04257

TRANSFORMATION OF DETERMINISTIC AND STOCHASTIC PROCESSES IN HYDROLOGY,
Arizona Univ., Tucson.
Chester C. Kisiel.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 75, p 600-607, 1967. 8 p, 23 ref.

Descriptors: *Stochastic processes, *Parametric hydrology, Linear programming, Input-output analysis, Model studies, Statistical models, Synthetic hydrology, Forecasting, Streamflow forecasting, Statistical methods, Time series analysis.
Identifiers: *Stochastic hydrology.

The theory of random functions forms the mathematical foundation of parametric and stochastic hydrology and shows their inherent unity. The stochastic approach is the more general. The theory of random functions is employed to predict the output statistics of a variety of transformation processes of interest in hydrology: rainfall to runoff or reservoir inflow to reservoir outflow. In general, such prediction is possible only for linear systems with or without memory. It is recognized that hydrologic transformations are nonlinear; yet, it is suggested that linear systems theory provides a first-order approximation to changes in output statistics for planned or unplanned modifications of the hydrologic environment. The changes in input-output statistics may be used as a measure of linearity of basin response. These nonstationarities as introduced by human manipulation of watershed response are important to the prediction problem, and thus to the economic design of hydraulic structures subjected to hydrologic events whose average return periods change as a result of man's intervention. (Knapp-USGS)
W70-04258

A CASE FOR THE SIMULTANEOUS APPLICATION OF DETERMINISTIC AND STOCHASTIC METHODS IN HYDROLOGY,
Manchester Coll. of Science and Technology (England).
For primary bibliographic entry see Field 04A.
W70-04259

EFFECT OF WATERSHED COVER ON OVERLAND FLOW FROM A MAJOR STORM IN SOUTHWESTERN WISCONSIN,
Forest Service (USDA), La Crosse, Wis.
For primary bibliographic entry see Field 02E.
W70-04316

APPLICATION OF A COMPUTER MODEL TO A DESERT WATERSHED,
Arizona Univ., Tucson. Dept. of Watershed Management.
J. H. Kitchen, and J. L. Thames.
Progressive Agriculture in Arizona, Vol 21, No 6, p 12-13, November-December 1969. 1 fig.

Descriptors: *Arizona, *Watershed management, *Computer models, *Runoff, *Small watersheds, Hydrologic cycle, Model studies, Hydrographs, Deserts.
Identifiers: *Purdue University Watershed Model, Tucson Basin, Arizona.

Approximately five percent of the total precipitation which falls on Arizona deserts is retained for man's use. More efficient watershed management would be possible if runoff could be accurately predicted. The most promising new method is watershed modeling using computers. Although the Purdue University model was designed for use on cultivated land in Indiana, it was chosen for study of a small desert watershed in the Tucson Basin of Arizona. The model was applied without modification and the result was a close agreement in general shape and size between the predicted and actual hydrograph. The differences that did occur may be the result of the uneven rainfall, as the model assumes uniform rainfall distribution. The study indicates that practical working watershed models can be developed. (Carr-Arizona)
W70-04397

HYDROGEOLOGY OF THE RIO GRANDE VALLEY AND ADJACENT INTERMONTANE AREAS OF SOUTHERN NEW MEXICO,
New Mexico State Univ., University Park. Water Resources Research Inst.
W. E. King, J. W. Hawley, A. M. Taylor, and R. P. Wilson.
New Mexico State University, Las Cruces, Water Resources Research Institute, Report No 6, June 1969. 141 p, 6 fig, 4 tab, 79 ref, map.

Descriptors: *Hydrogeology, *Aquifers, *New Mexico, *Groundwater, *Geomorphology, Geology, Rio Grande, Groundwater barriers, Groundwater basins, Semiarid climates, Soils, Geologic formations, Stratigraphy, Wells, Water chemistry.
Identifiers: *Rio Grande Valley.

The region under investigation is a 3600 square-mile area of southern New Mexico lying along the Rio Grande Valley. The local mountains are mainly of the block-faulted type. Consolidated rocks are a primary barrier to the movement of groundwater and these rocks serve as an important source of the dissolved solids found in local water supplies. There are four major hydrogeologic units of these rocks: Precambrian and Tertiary igneous intrusive and metamorphic rocks; Paleozoic, late Mesozoic, and early Tertiary carbonate and other clastic sedimentary rocks; Tertiary volcanic and associated sedimentary rocks; and late Cenozoic basalts. The two major groundwater reservoirs in the region are the late Quaternary Rio Grande Valley fill (80 feet thick) and the Miocene to mid-Pleistocene Santa Fe Group basin fill (3500 feet thick). The Valley fill is capable of high-yield aquifers and is an important water resource for New Mexico. The upland basin fill has less permeable aquifer beds and therefore its wells do not produce as much water. (Carr-Arizona)
W70-04399

THE CLIMATES OF BAJA CALIFORNIA (IN SPANISH),
Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Geografia; and Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Geografia.
For primary bibliographic entry see Field 02B.
W70-04409

2B. Precipitation

A SUMMARY OF SEASONAL TEMPERATURE AND PRECIPITATION DATA FOR THE INTERIOR FORESTED AREA OF ALASKA,
Forest Service (USDA), Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station.
Robert W. Funsch.
USDA Forest Serv Res Note NOR-9, 1964. 50 p, 1 fig, 45 tab.

Descriptors: *Climatic data, *Subarctic, Air temperature, Alaska, *Precipitation (Atmospheric), Meteorology, Seasonal.
Identifiers: Boreal forests, Growing season, Degree days.

Mean extreme air temperatures, growing degree days, dry days (<0.01-in ppt.) and precipitation were summarized by 5-day intervals for 22 stations in central Alaska for April 1 through October 31 for the period 1946 through 1961 as an aid for interpreting forest research results. The range of one standard deviation was computed for growing degree days, dry days, and precipitation. (Helmers-Forest Service)
W70-04066

ISOTOPIC COMPOSITION AND ORIGIN OF THE ATMOSPHERIC WATER VAPOR IN THE REGION OF LAKE LEMAN (IN FRENCH),
Pisa Univ. (Italy). Lab. of Nuclear Geology.
For primary bibliographic entry see Field 02K.
W70-04304

EFFECTS OF WEATHER MODIFICATION ON PLANT AND ANIMAL COMMUNITIES,
Michigan Univ., Ann Arbor. School of Natural Resources.
Charles F. Cooper.
American Association for the Advancement of Science, Committee on Arid Lands, Symposium on Weather Modification, New York, December 30, 1967. Miss 11 p, 9 ref.

Descriptors: *Weather modification, *Artificial precipitation, Cloud seeding, *Biological communities, Ecology, *Ecosystems, *Arid lands, Semiarid climates, Social aspects, Rainfall.
Identifiers: *Ecological effects.

A TEMPORARY CHANGE IN PRECIPITATION MAY ALTER RATES AND PATHWAYS THROUGH WHICH ENERGY IS CHANNELLED, BUT THE STRUCTURE OF THE SYSTEM IS ONLY SLIGHTLY MODIFIED. However, with a long term increase in rainfall, altered patterns of reproduction and growth may cause the emergence of an entirely new community structure. Given certain assumptions as to the nature of the weather changes, one may hypothesize the following ecological effects in arid regions: (1) species will respond as individuals, not as communities; (2) biological changes from a given percentage increase in rainfall will be greatest in semiarid climates and somewhat less in arid regions, (3) areas of uniform precipitation will be the most susceptible to the planned weather changes; (4) communities with stable populations will be the most sensitive to climatic change; (5) disappearance of a species from an area will be more the result of competition from favored species already present than of competition from invaders; and (6) moderately grazed livestock range is likely to change more in species composition than either heavily grazed or ungrazed areas. These hypotheses, based almost entirely on inference, await testing and refining with empirical data. Ecology is at the threshold of useful predictions which could be employed in the political decision framework. (Carr-Arizona)
W70-04391

THE CLIMATES OF BAJA CALIFORNIA (IN SPANISH),
Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Geografia; and Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Geografia.
Enriqueta Garcia, and Pedro A. Mosino.
Comite Nacional Mexicano para el Decenio Hidrologico Internacional, Memoria 1966-1967, 1968. p 29-56 21 fig, 1 tab, 13 refs, 1 append., 1 map.

Descriptors: *Climatic zones, *Arid lands, *Mexico, *Precipitation (Atmospheric), Air circulation, Temperature, Rainfall disposition, Variability, Winter, Summer.
Identifiers: *Baja California.

The peninsula of Baja California contains stretches of extremely arid land owing to climatic fluctuations. The extreme northwest region receives most of its precipitation during winter from a Mediterranean type of regime. The extreme southeast portion has a summer rainfall regime. The intermediate area receives rain from either or both regimes. These variations in climate, rainfall, temperature and air movements are discussed in depth and are accompanied by detailed charts and maps. (Moore-Arizona)
W70-04409

COLD AIR DRAINAGE ON A FORESTED MOUNTAIN SLOPE,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 02D.
W70-04444

2C. Snow, Ice, and Frost

SNOW ACCUMULATION IN RELATION TO FOREST CANOPY,
Colorado State Univ., Fort Collins. Natural Resources Center.
J. Meiman, H. Frochlick, and R. E. Dils.
Available from the Clearinghouse as PB-189 782, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 8 p, 1 tab, 3 fig, 2 ref. OWRR Project A-002-COLO.

Descriptors: *Snow management, *Snow pack, Snow, Snowfall.

Maximum snowpack water equivalent is measured at 123 points in the spring of 1966, 1967, and 1968. These points are distributed over three transects within a 4 square mile area in the Colorado Front Range. The north-facing slope ranges in elevation from 2900 to 3300 meters covered by Picea engelmanni and Abies lasiocarpa at the upper elevations and Pinus contorta at the lower. Water equivalent increases an average of 42mm/100m although only 28% of the total variance in water equivalent is associated with elevation. Forest cover measured by a Lemmon spherical densiometer within a cone of 114 deg is significant in only one of the three years. Neither corwn cover by compass quadrants, crown cover within a cone of 21 deg, not timber stand size classifications improve on the 114 deg cone canopy measurement in explaining snow accumulation variability. Individual points vary widely in their relative accumulation from year to year; the coefficient of determination for 1966 versus 1968 water equivalent is only 25%. Snow water equivalent versus snow depth gives r values of 0.86, 0.90, and 0.73 for the three years respectively.
W70-04056

CONTROLLED ACCUMULATION OF BLOWING SNOW,
Colorado State Univ., Fort Collins. Natural Resources Center.
J. L. Rasmussen.
Available from the Clearinghouse as PB-189 783, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Completion Report, June 13, 1969. 15 p, 8 ref. OWRR Project A-004-COLO.

Descriptors: *Snow management, Snowpack, *Snow fences, Water yield improvement.

An experiment designed to trap falling snow and control drifting snow over the high alpine regions of the Colorado Rocky Mountains is described. The experiment is based on the fact that a wind shift occurs following many snow occurrences over this region and a snow fence system was developed to act both as a trap for falling snow and as a channelling mechanism to control drifting snow. The report describes various fence designs that were tested and provides photographic evidence of the fence systsm's influence on the blowing snow. The system was effective in creasing the volume of snow in the target region but the density of snow in the controlled drift was found to be only eighty percent of the density in adjacent natural drift.
W70-04057

THE INFLUENCE OF FREEZING AND THAWING ON SOIL MOISTURE,
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
W. L. Pelton, C. A. Campbell, and W. Nicholaichuk.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan Univ, Nov 15-16, 1967, p 241-267, 1968. 27 p, 12 fig, 33 ref.

Descriptors: *Soil water movement, *Frozen soils, *Freezing, *Thawing, Soil moisture, Grasslands, Rainfall, Infiltration, Snowmelt, Snow, Runoff, Soil erosion, Moisture content, Permeability, Frost heaving.
Identifiers: *Canada, *Saskatchewan, Swift Current.

The influence of freezing and thawing on soil moisture is discussed in relation to the prairie region of Canada, where the rainfall is limited. Winter moisture can be conserved by trapping the snow on the soil surface and by infiltration of snowmelt into the soil. However, infiltration rates of frozen soil vary widely and depend upon the soil moisture content at the time of freezing. Soils which are dry during the fall are less susceptible to runoff and erosion in the spring than those which were frozen with high moisture content. Thermally induced moisture translocation is also a factor contributing to the reduction of infiltration rates. A literature review summarizes research findings related to permeability of frozen soils, moisture relocation, frost heaving and rate and depth of freezing and thawing. Field and laboratory studies of soil temperatures and moisture contents at Swift Current, Saskatchewan are presented. (Carstea-USGS)
W70-04112

THE ROLE OF STRESS CONCENTRATION IN SLAB AVALANCHE RELEASE,
Forest Service (USDA), Fort Collins. Rocky Mountain Forest and Range Experiment Station.
R. A. Sommerfeld.
Journal of Glaciology, Vol 8, No 54, p 451-462, 1969.

Descriptors: *Snow, *Avalanches, Mechanical properties, Snow management, Snowpacks, Colorado.
Identifiers: *Brittle fracture, Slab avalanches.

Slab avalanches are shown to be released by brittle fracture. An analogy is drawn in which the snowpack is considered to be a macroscopic, molecular model of glass. The analogy is examined qualitatively from two viewpoints: the Griffith fracture criterion, and stress concentration theory. The details of fracture propagation in a layered snowpack are explained by means of stress concentration theory, and many details of slab avalanches are shown to be consistent with the proposed mechanism. The significance of various fracture surface markings is pointed out.
W70-04198

0-18/0-16 RATIOS IN SNOW AND ICE OF THE HUBBARD AND KASKAWULSH GLACIERS,
Alberta Univ., Edmonton. Dept. of Geology; and Alberta Univ., Edmonton. Dept. of Physics.
For primary bibliographic entry see Field 02K.
W70-04260

2D. Evaporation and Transpiration

AN EXPERIMENTAL STUDY OF THE UPTAKE OF WATER BY SOYBEAN ROOTS,
Illinois Univ., Urbana. Dept. of Agronomy.
Arnold Klute.
Available from the Clearinghouse as PB-189 788, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Illinois Water Resources Center, Research Report No 29, Jan 1970. 32 p, 5 tab, 12 fig, 7 ref. OWRR Project A-023-ILL.

Descriptors: *Evapotranspiration, Evaporation, Transpiration, *Soil water movement, Unsaturated flow, Soil moisture, *Soil-water-plant relationships.
Identifiers: *Water uptake, Source function, *Root density.

The water extraction from soil by plant roots was treated by assuming that such extraction could be represented as a continuously distributed sink (negative source) function. Preliminary results with soybeans grown in soil columns showed that a small part of the root system could extract most of the water used in transpiration. Root density as measured by root length per unit volume of soil was not directly correlated with water uptake. Both the hydraulic conductivity of the soil and root density played a major role in determining the rate of extraction of water at a given depth in the soil. Water uptake per unit root length ranged up to about 0.5 cm3/cm of root/day. This kind of data gives more insight into the conditions at the root-soil interface. The experimental work in this project was developed from a numerical analysis which was supported by an earlier OWRR project (Project No. 65-03G), and is an example of a basic ap-

proach to the study of the interaction of the plant with its environment in which the available degree of understanding of the water flow process in soil is brought to bear upon the plant-soil interaction. The importance of evapotranspiration is well known in the hydrologic cycle. The experimental work described in this report makes a further contribution toward our understanding of this process.
W70-04069

SODIUM HAZARD OF BICARBONATE IRRIGATION WATERS,
California Univ., Riverside. Dept. of Soils and Plant Nutrition.
For primary bibliographic entry see Field 02K.
W70-04104

NEW DESIGN OF A LOW-COST HYDRAULIC LYSIMETER SYSTEM FOR FIELD MEASUREMENT OF EVAPOTRANSPIRATION,
Hebrew Univ., Jerusalem (Israel). Dept. of Soil Science; and National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
D. Hillel, S. Gairon, V. Falkenflug, and E. Rawitz.
Israel Journal of Agricultural Research, Vol 19, No 2, p 57-63, April 1969. 3 fig, 1 plate, 6 ref.

Descriptors: *Lysimeters, *Equipment, *Evapotranspiration, *Instrumentation, Water balance, Arid lands, Costs, On-site data collections.
Identifiers: *Israel, Negev Desert.

A low-cost hydraulic-pressure lysimeter system was constructed which gives reproducible data of relatively high accuracy. It can continuously weigh 8 cubic meters of soil for evapotranspiration and water-balance studies. It should be possible to construct such a centrally-monitored four-lysimeter complex for about $4000. Maintenance costs are low due to the absence of moving parts. This system has been in operation for the past three years in the Negev Desert at Gilat, Israel. (Carr-Arizona)
W70-04401

TRANSPIRATION, EVAPORATION AND DEEP DRAINAGE LOSSES FROM AN ORANGE PLANTATION,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
For primary bibliographic entry see Field 03F.
W70-04402

COLD AIR DRAINAGE ON A FORESTED MOUNTAIN SLOPE,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
James D. Bergen.
J. Applied Meteor Vol 8, No 6, Dec 1969, p 884-895.

Descriptors: *Air circulation, Fluid mechanics, *Winds, Thermal radiation, Mountain climate, Climatology, Colorado.
Identifiers: *Katabatic flow, Mesoclimate.

The nocturnal cold airflow on a small forested slope was studied in an attempt to relate the volume and velocity of flow to the net radiation balance of the slope. The hillside, with an approximately 30% grade, was about 400 m long and covered with an uneven-aged spruce-fir stand of about 20 m height. The location was near Fraser, Colo., at an altitude of 3000 m. The vertical profiles of windspeed and air temperature were measured at various points on a transect approximating a streamline segment down the hill for several nights. Net radiation was measured at the base of the transect. Canopy closure and tree heights and diameters were measured on sample plots along the transect. The vertical profiles of potential temperature deficit and windspeed at the various station show approximate similarity when scaled by the height of the lowest inversion and by the average velocities and potential temperature deficits below that inversion. The latter varies in a nearly linear manner down the slope, and the inversion heights appear to be relatively constant over the range of net radiation rates observed. Assuming a corresponding analytical similarity for the equations of motion and the sensible heat balance, the last two phenomena are found to imply that U sub m varies as the one-half power of capital delta capital theta, capital delta capital theta varies as the two-thirds power of R sub o, and U sub m divided by the one-half power of gamma varies as chi where U sub m is the average velocity indicated above, capital delta capital theta the potential temperature drop down the slope, gamma the sine of the angle of the slope to the horizontal along the streamline, chi the downslope distance from the virtual origin of the flow measured along the streamline and R sub o the average net radiation loss on the slope. The data appear to confirm these results. The constants of proportionality calculated from the topographic contours, the estimated foliage distribution, and the scaled profiles of windspeed and potential temperature deficit are in fair agreement with observations.
W70-04444

2E. Streamflow and Runoff

STATISTICAL SUMMARIES OF ILLINOIS STREAMFLOW DATA,
Geological Survey, Champaign, Ill.
George W. Curtis.
Geological Survey Open-file report, 1969. 300 p, 1 fig, 1 append, index.

Descriptors: *Data collections, *Streamflow, *Hydrologic data, *Illinois, Statistics, Low flow, Hydrographs, Duration curves, Surveys.
Identifiers: Streamflow summary data, High flow.

Cooperative agreements between the U.S. Geological Survey and organizations of the State of Illinois for the systematic collection of streamflow records began in 1908. The data have been published in the form of daily discharges, and monthly and yearly summaries. A list of the publications (Water-Supply Papers) in which the records are published is given in the appendix. Three computer summaries of streamflow data given are of flow-duration, low-flow, and high-flow. This basic data release includes summaries for all gaging stations having five or more years of record as of September 30, 1966. The summary tables contain statistical information for 190 stations. (Knapp-USGS)
W70-04091

FLOOD PLAIN INFORMATION, ARKANSAS RIVER AND TRIBUTARIES, PULASKI COUNTY, ARKANSAS, PART 1.
Corps of Engineers, Little Rock, Ark.
For primary bibliographic entry see Field 04A.
W70-04094

FLOOD PLAIN INFORMATION - COASTAL FLOODING OF VIRGINIA BEACH, VIRGINIA.
Corps of Engineers, Norfolk, Va.
For primary bibliographic entry see Field 04A.
W70-04095

WATER RESOURCES AND DEVELOPMENT IN MASON VALLEY, LYON AND MINERAL COUNTIES, NEVADA, 1948-65,
Geological Survey, Carson City, Nev.
For primary bibliographic entry see Field 02F.
W70-04098

FLOOD PLAIN INFORMATION, SALADO CREEK, SAN ANTONIO, TEXAS.
Corps of Engineers, Fort Worth, Tex.
For primary bibliographic entry see Field 04A.
W70-04100

SOME CHARACTERISTICS OF RIVER AND SPRING RUNOFFS IN THE KARSTIC AREAS OF ESTONIA (RUSSIAN),
T. F. Eypre.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostnykh i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 96-106, 1969. 10 p, 2 fig, 5 tab, 7 ref.

Descriptors: *Runoff, *River flow, *Springs, *Karst, Mapping, Gaging stations, Watersheds (Basins), Frequency, Discharge (Water), Water resources, Seasonal, Dry seasons, Water resources development.
Identifiers: *USSR, Estonia.

Hydrological characteristics of the rivers and springs of the karstic highlands of Estonia were investigated. Areas characterized by large mean annual discharges and the presence of some internal regularity were identified. It is recommended that the future water supply for the city of Tallin, Estonia, should be drawn from the total discharge of the rivers and springs characterized by positive karstic feeding. (Gabriel-USGS)
W70-04109

POTOMAC-SHENANDOAH RIVER BASIN.
Virginia Dept. of Conservation and Economic Development, Richmond. Div. of Water Resources.
For primary bibliographic entry see Field 06B.
W70-04111

MAGNITUDE AND FREQUENCY OF MISSOURI FLOODS,
Geological Survey, Rolla, Mo. Water Resources Div.
E. H. Sandhaus, and John Skelton.
Water Resources Report 23, Missouri Geological Survey and Water Resources, Dec 1968. 276 p, 7 fig, 1 plate, 2 tab, 14 ref, 2 append.

Descriptors: *Floods, *Missouri, *Data collections, *Statistics, Statistical methods, Frequency analysis, Flood forecasting, Stage-discharge relations, Streamflow, Climates, Topography, Regression analysis.
Identifiers: Flood data, Flood frequencies.

A statistical analysis was made of available flood-flow information from streams in the State of Missouri. Equations are presented for estimating the magnitude of future floods with recurrence intervals of 1.2, 2.33, 5, 10, 25, and 50 years at ungaged sites on most Missouri streams. Only two basin characteristics, drainage area and the average slope of the stream, are required to solve the equations. Appendices contain information on peak stages and discharges at gaging stations and miscellaneous sites, and flood-frequency data for gaging stations. (Knapp-USGS)
W70-04114

SIMULATION OF DAILY STREAMFLOW,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Leo R. Beard.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 78, p 624-632, 1967. 9 p, 5 tab, 4 ref.

Descriptors: *Synthetic hydrology, *Statistical models, *Stochastic processes, *Streamflow forecasting, Markov processes, Statistical methods, Correlation analysis, Regression analysis, Simulation analysis.
Identifiers: Daily streamflow model, Watershed models.

The stochastic process of daily streamflow generation is represented by a mathematical model including more than one element of serial correlation

and a random component in the generation of a daily streamflow. Differences in statistical and correlation characteristics between high flows and low flows are evaluated and tested. A generalized equation for generating daily streamflow at a single location is suggested. (Knapp-USGS)
W70-04130

MECHANICS OF FLOW IN OPEN CHANNEL SYSTEMS,
California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 08B.
W70-04296

CHANNEL CAPACITY AND FLOOD CHARACTERISTICS FOR SELECTED REACHES OF ELK CREEK AND TRIBUTARIES, DOUGLAS COUNTY, OREGON,
Geological Survey, Portland, Oreg.
Eugene A. Oster, and C. H. Swift, III.
Geological Survey Open-file Report, Oct 1969. 284 p, 256 fig, 1 plate, 3 tab, 2 ref.

Descriptors: *Floods, *Oregon, *Stage-discharge relations, *Data collections, Profiles, Hydrologic data, Hydrographs, Hydrograph analysis, Streamflow, Depth-area-duration analysis, Duration curves.
Identifiers: *Flood data, Douglas County (Oregon).

A study was made of the channel capacity and flood characteristics for selected reaches of Elk Creek and two of its tributaries, Pass and Yoncalla Creeks, Oregon. Water-surface profiles and the area inundated by floods with 2-year and 10-year recurrence intervals, and by the maximum flood of record, which occurred February 10, 1961, were made. The step-backwater method was used to define the flood profiles needed for delineating the areas inundated. Cross sections, high-water profiles, and other data used to develop the flood profiles are presented. (Knapp-USGS)
W70-04311

BASIC HYDROGEOLOGIC DATA, PINE RIDGE INDIAN RESERVATION, SOUTH DAKOTA,
Geological Survey, Vermillion, S. Dak.
For primary bibliographic entry see Field 02F.
W70-04314

EFFECT OF WATERSHED COVER ON OVERLAND FLOW FROM A MAJOR STORM IN SOUTHWESTERN WISCONSIN,
Forest Service (USDA), La Crosse, Wis.
Richard S. Sartz.
Forest Service Research Note NC-82, 1969. 4 p, 2 fig, 4 ref.

Descriptors: *Rainfall-runoff relationships, *Vegetation effects, *Wisconsin, Runoff forecasting, Streamflow forecasting, Alfalfa, Forests, Peak discharge, Hydrographs, Hydrograph analysis, Rainfall intensity.
Identifiers: Driftless Area (Wis).

A runoff study in the Driftless Area of Wisconsin showed that both total flow and peak rate of flow from a 3-hour, 4-inch rain were strongly affected by the watershed cover. Peak flows ranged from 2.42 inches per hour for alfalfa meadow to .010 inch per hour for undisturbed forest. The timing of flow on open-land and forested watersheds was similar. (Knapp-USGS)
W70-04316

THE INTERACTION OF INTERNAL WAVES WITH AN UNSTEADY NON-UNIFORM CURRENT,
Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics.
Yee-Chang Wang.
Journal Fluid Mechanics, Vol 37, Part 4, p 761-771, July 28, 1969. 11 p, 7 ref, 3 append.

Descriptors: *Waves (Water), *Ocean currents, *Non-uniform flow, *Unsteady flow, Hydraulics, Mathematical studies, Stratification, Thermocline, Ocean circulation, Thermal stratification.
Identifiers: Incompressible flow.

On the assumptions of incompressibility, negligible thermal conduction, salinity diffusion and viscosity, simple expressions are derived for the conservation equations of mass, momentum and energy when internal waves encounter an unsteady non-uniform current. These expressions of conservation equations are valid for all kinds of internal waves without regard to their different characteristics. From the dynamical conservation equations, we find that a stress-like term, the 'excess momentum flux tensor,' plays an important role in the interaction between internal waves and an unsteady non-uniform current. Furthermore, it is deduced from the energy balance equation that, in the encounter of interfacial waves with a steady non-uniform current in a two-liquid system, the waves are amplified in an adverse current but suppressed in an advancing current as a result of interaction of the waves with the current. This conclusion may explain the large amplitudes sometimes observed in internal waves near the confluence of currents and near fronts at the thermocline, the region in the ocean where the density gradient is a maximum. (Knapp-USGS)
W70-04326

SURFACE WATER RESOURCES OF SOUTH AFRICA,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
D. C. Midgley, and W. V. Pitman.
Witwatersrand University Hydrological Research Unit Report No 2/69, Aug 1969. 127 p, 29 fig, 23 tab, 22 ref, 7 append.

Descriptors: *Water resources, *Water resources development, *Surface waters, Streamflow, Rainfall-runoff relationships, Water storage, Hydrologic data, Data collections, Hydrogeology, Duration curves, Depth-area-duration analysis, Hydrographs, Frequency analysis, Flow characteristics, Low flow, Evaporation, Sedimentation, Silting, Mass curves.
Identifiers: *South Africa.

All comparatively long and reliable South African streamflow records that are reasonably unaffected by changing upstream land use were analyzed. Drought-flow sequences were abstracted and subjected to extreme-value analysis to yield critical mass curves as functions of return period. Discrete values are tabulated and referred to a regional drought-characteristic map. Storage analyses of the critical mass curves yield generalized co-axial diagrams relating gross draft, recurrence interval, month of year, and storage requirement. A generalized diagram is provided for each drought-characteristic region. Rainfall-runoff relationships were found to be influenced more strongly by vegetal cover than by any other catchment characteristic. The main drainage systems of the Republic were subdivided into secondary, tertiary and quaternary subcatchments. From regional rainfall-runoff relationships and isohyetal maps, mean river flow was computed for each quaternary subcatchment. (Knapp-USGS)
W70-04334

RESPONSE OF GAS-PURGED MANOMETERS TO WATER-LEVEL SURGES,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 07B.
W70-04337

FLOOD OF AUGUST 1969, RICHMOND QUADRANGLE, RICHMOND, VIRGINIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-04348

FLOOD OF AUGUST 1969 ON MAURY RIVER AT BUENA VISTA, VIRGINIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-04349

FLOOD OF AUGUST 1969, DREWRYS BLUFF QUADRANGLE, RICHMOND, VIRGINIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-04350

RESERVOIR FLOOD ROUTING ANALYSIS,
Sheffield Univ. (England).
E. J. Sarginson.
Civ Eng Pub Works Rev, Vol 64, No 752, p 275-277, Mar, 1969. 2 p, 3 fig, 2 tab, 4 ref.

Descriptors: Flood control, Reservoirs, *Flood routing, Flood peaks, *Flood hydrographs, Mathematical analysis, Reservoir storage, Floods, *Reservoir operation, Discharges, Flow rates, Regulation, Foreign design practices.
Identifiers: *Flood hydrology, Flood stages, *Reservoir management, Accuracy, Great Britain.

Using an arithmetical integration is the usual procedure for routing a flood of variable intensity through a reservoir. The procedure is tedious when a large number of short steps must be considered for accuracy. A more rapid analytical solution is desirable. Floods of constant intensity are solved easily in terms of Gould's function, and Mathieson has extended the method to include reservoirs in which the surface area increases with rising water level. For a flood of variable intensity, an analytical solution is not managed easily. A method is presented for calculating a rising flood using the weir formula in the usual form. Gould's function is recommended for the constant part of the flood hydrograph. A further method is developed for the falling flood. An example of the proposed routing analysis method gives a solution identical to results of the more lengthy arithmetical procedure. (USBR)
W70-04543

2F. Groundwater

SOLUTION GEOCHEMISTRY OF THE WATER OF LIMESTONE TERRAINS,
Kentucky Water Resources Inst., Lexington.
For primary bibliographic entry see Field 02K.
W70-04061

GROUNDWATER RESOURCES OF GREGG AND UPSHUR COUNTIES, TEXAS,
Geological Survey, Austin, Tex.
Matthew E. Broom.
Report published and distributed by Texas Water Development Board, PO Box 12386, Austin Tex 78711. Texas Water Development Board Report 101, Oct 1969. 76 p, 16 fig, 9 tab, 41 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *Texas, Water wells, Water yield, Transmissivity, Water quality, Data collections, Hydrologic data, Hydrogeology, Water levels.
Identifiers: Gregg County (Tex), Upshur County (Tex).

Gregg and Upshur Counties, in northeast Texas, are underlain by two aquifers that are capable of sustaining additional development. The aquifers consist of the Wilcox Group and Carrizo Sand (Carrizo-Wilcox aquifer) and the Queen City Sand. Of the total pumpage of 3.02 mgd in 1966, 2.84 mgd was from the Carrizo-Wilcox aquifer. At the 1966 hydraulic gradient (8 feet per mile), about 12,000 acre-ft per year (10.9 mgd) was being transmitted through this aquifer. The amount that is perennially available is not known, but it is probably at least two times that pumped in 1966. The water in the Carrizo-Wilcox generally is soft,

but with high chloride content. The Queen City Sand, which crops out over nearly 90% of the area, is relatively undeveloped. In 1966, only 200 acre-ft (0.18 mgd) was pumped from the aquifer. The transmissibility of the aquifer is about 5,000 gpd per foot as compared to 20,000 gpd per foot for the Carrizo-Wilcox. The water in the Queen City Sand is uniformly low in mineralization except for iron. (Knapp-USGS)
W70-04092

GROUNDWATER RESOURCES OF KERR COUNTY, TEXAS,
Geological Survey, Austin, Tex.
Richard D. Reeves.
Report published and distributed by Texas Water Development Board, PO Box 12386, Austin, Texas 78711. Texas Water Development Board Report 102, Nov 1969. 58 p, 12 fig, 7 tab, 30 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *Texas, Water wells, Water yield, Transmissivity, Water quality, Data collections, Hydrologic data, Hydrogeology, Water levels.
Identifiers: Kerr County (Tex).

The principal water-bearing units in Kerr County, Texas, are the Hosston and Sligo Formations, the Hensell Member of the Pearsall Formation, and the Edwards and associated limestones. The Glen Rose Limestone is of lesser importance. A total of about 3,600 acre-feet or 3.2 mgd of groundwater was pumped from wells in 1966. Additional groundwater is available for development. An average of about 52,000 acre-feet per year is discharged from the Edwards and associated limestones through springs and seeps. An additional 6,000 acre-feet is discharged from the upper member of the Glen Rose Limestone. However, a substantial increase in withdrawals from the Edwards and associated limestones would necessarily result in a reduction in the natural groundwater discharge, which in turn would result in a reduction in the base flow of the Guadalupe River. The chemical quality of the groundwater in the aquifers is generally suitable for public supply and industrial use, and is excellent for irrigation. (Knapp-USGS)
W70-04093

WATER RESOURCES AND DEVELOPMENT IN MASON VALLEY, LYON AND MINERAL COUNTIES, NEVADA, 1948-65,
Geological Survey, Carson City, Nev.
C. J. Huxel, Jr., and E. E. Harris.
Nevada Division of Water Resources Bulletin No 38, 1969. 77 p, 13 fig, 3 plate, 26 tab, 30 ref.

Descriptors: *Water resources development, *Nevada, *Groundwater, Surface waters, Conjunctive use, Water supply, Irrigation water, Water yield, Water wells, Aquifers, Alluvium, Specific capacity.
Identifiers: Mason Valley (Nev).

Mason Valley comprises 510 square miles in the Walker River basin of western Nevada. Precipitation ranges from about 5 inches per year on the valley floor (altitude 4,700-4,300 feet) to about 20 inches in the surrounding mountains. The Mason Valley floor is underlain by a thick sequence of alluvium and fan deposits that form the principal aquifer in the valley. The alluvium contains sand and gravel with transmissibilities in the range from 50,000 to 200,000 gpd per foot, and specific yields of about 20%. The total amount of water stored in the uppermost 50 feet of saturation is about 1,100,000 acre-feet. East and West Walker Rivers contributed an average of 216,000 acre-feet per year during the period 1948-65. Conjunctive use of surface and groundwater, together with salvage of natural water losses, would yield as much as 100,000 acre-feet per year. (Knapp-USGS)
W70-04098

UNDERGROUND STORAGE OF IMPORTED WATER IN THE SAN GORGONIO PASS AREA, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 04B.
W70-04102

KARST AND ASSOCIATED UNDERGROUND WATERS OF THE SOUTHWESTERN PART OF THE DONETS BASIN (RUSSIAN),
Akademiya Nauk URSR, Kiev. Instytut Geologichnykh Nauk.
B. A. Korzhenevskiy.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostnykh i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 60-63, 1969. 4 p.

Descriptors: *Karst, *Aquifers, *Groundwater, *River basins, Geology, Crystalline rocks, Sedimentary rocks, Fissures (Geology), Boreholes, Limestones, Erosion, Weathering.
Identifiers: *USSR, Donets Basin.

General and historical geology are used in analysis of aquifers of the karstic area located in the southwestern part of the Donets Basin. In this area four water-bearing horizons are identified as follows: (1) Crystalline rocks and the products of their weathering; (2) Devonian fissure-bearing rocks (sandstones, slates, conglomerates); (3) Lower Carbonaceous limestones and sands; and (4) Pre-Tertiary sand and clay formations. Karstic processes in this area are associated with the Lower Carbonaceous limestones. (Gabriel-USGS)
W70-04106

GROUNDWATER REGIME OF THE UPPER CRETACEOUS WATER-BEARING HORIZON OF THE LUGANSK REGION (RUSSIAN),
Voroshilovgrad Hydrogeological Station (USSR).
A. P. Rakitina, and M. V. Dvoskin.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostnykh i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 84-90, 1969. 7 p, 1 fig, 3 tab, 2 ref.

Descriptors: *Groundwater movement, *Aquifers, *Hydrogeology, Geology, Topography, Water sources, Discharge (Water), Climates, Boreholes, Water level fluctuations, Air temperature, Rivers, Seasonal, Filtration, Floods, Velocity, Precipitation (Atmospheric), Water balance.
Identifiers: Lugansk region, USSR.

The groundwater regime of the Lugansk region was investigated by using the Forchheimer equation and borehole data to calculate the effect of floods on water level fluctuations. The whole region may be considered as a source for the accumulation of the groundwater. The main source of Upper Cretaceous groundwater is the infiltration of atmospheric precipitation. In general, the amplitude of water level fluctuations depends on the amounts of precipitation, evaporation, the thickness of the aeration zone, and permeability. (Gabriel-USGS)
W70-04108

SOME CHARACTERISTICS OF RIVER AND SPRING RUNOFFS IN THE KARSTIC AREAS OF ESTONIA (RUSSIAN),
For primary bibliographic entry see Field 02E.
W70-04109

THE CONTINUITY BETWEEN GROUNDWATER FLOW SYSTEMS AND FLOW IN THE UNSATURATED ZONE,
Department of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Branch.
For primary bibliographic entry see Field 02G.
W70-04113

HYDROLOGICAL DOCUMENTATION FOR THE EXPLOITATION OF RESERVOIRS IN PERMEABLE SOLID ROCKS FOR THE PURPOSE OF ARTIFICIAL INFILTRATION,
Hydraulic Research Inst., Prague (Czechoslovakia).
For primary bibliographic entry see Field 03B.
W70-04118

ARTIFICIAL RECHARGE AND ITS POTENTIAL IN ILLINOIS,
Illinois State Water Survey, Urbana. Hydrology Section.
For primary bibliographic entry see Field 04B.
W70-04119

ARTIFICIAL CONTROL OF STATIC FISSURE-KARST WATER RESOURCES IN CARBONATE ROCKS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
For primary bibliographic entry see Field 04B.
W70-04120

ARTIFICIAL RECHARGE OF WATER THROUGH WELLS: EXPERIENCE AND TECHNIQUES,
For primary bibliographic entry see Field 04B.
W70-04122

A CONTRIBUTION TO THE TECHNIQUE FOR EVALUATION OF NATURAL AND WORKABLE RESOURCES OF NEAR-CANAL FRESH-WATER LENSES,
Moscow State Univ. (USSR); and All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
V. M. Shestakov, and I. P. Kravchenko.
Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 83-90, 1967. 8 p, 2 fig, 1 tab, 6 ref.

Descriptors: *Seepage, *Canals, *Recharge, *Analog models, Aquifers, Aquicludes, Model studies, Hydrogeology, Discharge (Water), Water yield, Water wells, Infiltration, Groundwater movement, Saline water intrusion.
Identifiers: *USSR.

The fresh-water lenses which are formed near large canals are as a rule hydraulically connected with the canal and located immediately over an aquicludes. For such conditions, a technique is presented for evaluating the workable resources when a linear water intake is located along canals. Analytical calculation methods and application of the modelling methods are described. For the 'hanging' lenses, approximate methods of calculation and methods of modelling, using solid and net-like electrical models, are presented. Also, the technical problems of hydrogeological investigations required for determining the initial hydrogeological parameters are discussed. (Knapp-USGS)
W70-04123

ON THE STORAGE COEFFICIENT OF FREE SURFACE AQUIFERS, CONSIDERING THE FLOW IN THE UNSATURATED ZONE (FRENCH),
Grenoble Univ. (France).
For primary bibliographic entry see Field 02G.
W70-04124

ARTIFICIAL RECHARGE THROUGH AUGMENTED BANK STORAGE,
Princeton Univ., N.J. Dept. of Civil and Geological Engineering.
For primary bibliographic entry see Field 04B.
W70-04125

GEOLOGIC AND HYDROLOGIC FACTORS RELATED TO ARTIFICIAL RECHARGE OF THE CARBONATE-ROCK AQUIFER SYSTEM OF CENTRAL ISRAEL,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04B.
W70-04126

THE SPREADING PATTERN OF INJECTED WATER IN A PERMEABILITY STRATIFIED AQUIFER,
Water Planning for Israel Ltd., Tel Aviv.
For primary bibliographic entry see Field 04B.
W70-04127

ELECTROMODELLING AS AN EFFECTIVE METHOD OF PROGNOSTICATING RESOURCES OF UNDERGROUND WATER DURING THEIR REPLENISHMENT,
For primary bibliographic entry see Field 07C.
W70-04128

A GENERALIZED THEORY ON HYDRODYNAMIC DISPERSION IN POROUS MEDIA,
Technion - Israel Inst. of Tech., Haifa; and Water Planning for Israel Ltd., Tel Aviv.
J. Bear, and Y. Bachmat.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (Mar 19-26, 1967), International Association of Scientific Hydrology, Pub No 72, p 7-16, 1967. 10 p, 3 ref.

Descriptors: *Dispersion, *Flow, *Porous media, *Groundwater movement, *Tracers, Dye releases, Salts, Ion transport, Diffusion, Mathematical models, Mass transfer, Solutes, Aqueous solutions.
Identifiers: Hydrodynamic dispersion.

The phenomenon of hydrodynamic dispersion occurs in problems of underground mixing of waters of different quality. In these problems, any identifiable solute may serve as a tracer if its concentration distribution indicates the mixing. A review is given of the microscopic and macroscopic factors of the medium and the liquid, which affect the mixing phenomenon. A generalized macroscopic dispersion theory is based on the hydrodynamics of the microflow through a porous medium model and on statistical averaging procedures. The macroscopic parameters appearing in the averaged transport equations and their interrelations are analyzed. The problem of determining the tracer concentration distribution under field conditions is stated mathematically in the form of a set of equations with boundary and initial conditions. (Knapp-USGS)
W70-04129

GROUNDWATER FLOW SIMULATED ON COMPUTER AIDS NUCLEAR PLANT RADIOACTIVE WASTE STUDY,
Battelle-Northwest, Richland, Wash. Water Resources Systems Section.
For primary bibliographic entry see Field 05B.
W70-04309

HYDROGEOLOGICAL CONDITIONS OF THE TARKHANKUT KARSTIC DISTRICT OF CRIMEA (IN RUSSIAN),
Ye. V. L'vova.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostynykh i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 49-54, 1969. 6 p, 4 fig, 9 ref.

Descriptors: *Hydrogeology, *Mountains, *Karst, Sedimentary rocks, Carbonates, Geology, Mapping, Limestones, Sands, Sandstones, Water chemistry, Discharge (Water), Aquifers, Water supply, Water pollution, Geomorphology.
Identifiers: *USSR, Crimean karstic area.

The general hydrogeological conditions in the karstic district of Crimea are discussed on the basis of geological, geochemical, and hydrological information. The geological history of the district, a number of hydrogeological profiles, and the distribution and chemical composition of aquifers in Western Crimea are summarized. (Gabriel-USGS)
W70-04312

UNDERGROUND WATER REGIME OF THE MAIN RIDGE OF THE CRIMEAN MOUNTAINS (IN RUSSIAN),
Crimean Landslide and Hydrogeological Station (USSR).
G. D. Neklyudov.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostynykh i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions) Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, USSR, p 43-48, 1969. 6 p, 2 ref.

Descriptors: *Hydrogeology, *Hydrologic budget, *Aquifers, *Water supply, *Mountains, Boreholes, Water levels, Geology, Precipitation (Atmospheric), Forecasting, Forests, Snow, Geomorphology, Discharge (Water), Infiltration, Karst, Water chemistry, Springs.
Identifiers: *USSR, Crimea.

Discharge regime water level fluctuations, atmospheric precipitation, discharge forecasting, the effect of artificial factors (forest plantations) and geology of the Crimean Mountains are discussed on the basis of data recorded at 182 natural springs and 53 boreholes. The water balance regime of the Main Ridge is computed. (Gabriel-USGS)
W70-04313

BASIC HYDROGEOLOGIC DATA, PINE RIDGE INDIAN RESERVATION, SOUTH DAKOTA,
Geological Survey, Vermillion, S. Dak.
Donald G. Adolphson, and Michael J. Ellis.
South Dakota Geological Survey Water Resources Report No 4, 1969. 75 p, 2 fig, 7 tab, 91 ref.

Descriptors: *Water resources, *Data collections, *South Dakota, Water wells, Streamflow, Springs, Water quality, Hydrogeology, Hydrologic data, Aquifers, Streams, Water yield, Water supply.
Identifiers: Pine Ridge Indian Reservation (S Dak).

Basic hydrological data collected in the Pine Ridge Indian Reservation, South Dakota, are tabulated. The data collected include records of wells and springs, chemical analyses, streamflow, runoff, low-flow, and lithologic logs of wells. (Knapp-USGS)
W70-04314

MOJAVE RIVER BASIN GROUNDWATER RECHARGE WITH PARTICULAR REFERENCE TO THE CALIFORNIA FLOODS OF JANUARY AND FEBRUARY 1969,
Geological Survey, Menlo Park, Calif.
William F. Hardt.
Geological Survey Open-file Report, Dec 17, 1969. 13 p, 3 fig, 2 tab, 5 ref.

Descriptors: *Recharge, *Alluvium, *California, *Floods, Water spreading, Surface-groundwater relationships, Infiltration, Flooding, Water levels, Water level fluctuations, Hydrographs, Hydrologic budget, Water balance, Evapotranspiration.
Identifiers: Mojave River (Calif).

The floods of January and February 1969 in the Mojave River basin, California caused about $6 to $12 million damage. The floods also produced substantial benefits in recharge of the underlying aquifer at no capital cost. Aquifer recharge from March 1967 through March 1969 was about 300,000 acre-feet from surface flow in the Mojave River between The Forks and Afton Canyon. During the study period, consumptive use and pumping adjacent to the river was about 190,000 acre-ft. About 210,000 acre-ft of floodflow from January through March 1969 recharged the aquifer. This was the equivalent of about 2 years of normal water use. The change in storage for the basin was a net accretion of about 110,000 acre-ft. The value of the recharged water was about $18 million for the 25-month period. Consideration might be given to artificial diversion of controlled floodflow for recharge to the basin. Groundwater pumpage in the basin exceeds average natural recharge from flow in the Mojave River. Floodflows are highly unpredictable and give only temporary relief to the long-term continuous lowering of water levels. (Knapp-USGS)
W70-04323

DIFFUSION FROM A GASEOUS SOURCE IN A POROUS MEDIUM - A FIELD AND THEORETICAL COMPARISON,
Geological Survey, Idaho Falls, Idaho.
John B. Robertson.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D265-D273, 1969. 9 p, 5 fig, 5 ref.

Descriptors: *Diffusion, *Porous media, Groundwater movement, Tracers, Tracking techniques, Radioisotopes, Gases, Mathematical studies, Model studies, Laboratory tests.
Identifiers: *Gaseous diffusion, Tracer dispersion.

Small volumes of air containing a radioactive krypton-85 tracer were injected into fine-grained sediments at the National Reactor Testing Station, Idaho. Dissipation of the Kr-85 gas away from the injection points was observed by recording the gamma radioactivity in the holes. A mathematical model was adapted from a heat-flow analogy to estimate the amount of molecular diffusion occurring in the system. The observed field data match the theoretical diffusion curves closely, indicating that most of the observed outflow was due to diffusion. (Knapp-USGS)
W70-04338

TWO-DIMENSIONAL DISPERSION IN A GRANULAR-MEDIUM DISK SOURCE EMITTING AT CONSTANT RATE,
Geological Survey, Honolulu, Hawaii.
Akio Ogata.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D260-D264, 1969. 5 p, 11 ref.

Descriptors: *Groundwater movement, *Dispersion, *Tracers, *Mathematical studies, Mathematical models, Model studies, Flow, Porous media, Diffusion, Tracking techniques, Mass transfer, Convection, Ion transport.
Identifiers: Tracer dispersion.

A solution of the two-dimensional differential equation of dispersion from a disk source is developed utilizing a point-source solution which appears frequently in heat-transfer problems. Because of the complexity of the solution, expressions applicable along a given axis were obtained to facilitate computation of the dispersion coefficients for a given laboratory test. (Knapp-USGS)
W70-04339

EXPLOITATION TEST ON THE SUB-ALLUVIAL AND SUB-FLUVIAL MEUSE GROUNDWATER TO THE NORTH OF VERDUN (IN FRENCH),
For primary bibliographic entry see Field 04B.
W70-04351

ARTIFICIAL RECHARGE BY INDUCED INTERAQUIFER LEAKAGE,
Geological Survey, Columbus, Ohio.
For primary bibliographic entry see Field 04B.

W70-04352

RECHARGE AND WATER INJECTION IN UNDERGROUND AQUIFERS (IN FRENCH),
For primary bibliographic entry see Field 04B.
W70-04353

COMPARISON OF LABORATORY AND FIELD ANALYSES OF AQUIFER AND WELL CHARACTERISTICS AT AN ARTIFICIAL RECHARGE WELL SITE,
Geological Survey, Denver, Colo.; and Geological Survey, Little Rock, Ark.
A. I. Johnson, and R. T. Sniegocki.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 182-192, 1967. 11 p, 4 fig, 14 ref.

Descriptors: *Artificial recharge, *Recharge wells, Surveys, Aquifers, Observation wells, Alluvium, Sands, Gravels, Laboratory tests, Permeability, Transmissivity, Particle size, Storage coefficient, Specific capacity.
Identifiers: *Aquifer testing, Pumping tests.

Research on artificial recharge of alluvial deposits by means of recharge wells was carried out in the Grand Prairie region of Arkansas. Extensive test-drilling and construction of observation wells within the 24sq mi research site provided detailed information on the geology and hydrology of the deposits of Quarternary Age. Aquifer characteristics were determined by means of laboratory analysis of samples collected from the pilot test holes for the recharge wells and by conventional pumping-test in the field. On the basis of the laboratory analyses, a transmissibility of 60,000 gpd/ft, and a storage coefficient of 0.34 was predicted for the recharge test site. Later pumping tests and recharge tests in the field confirmed that the values of transmissibility predicted from laboratory analysis were comparable to those obtained by the field test. Slow drainage from the fine-textured portions of the aquifer resulted in a change in storage coefficient with time. However, the field data showed that the storage coefficient probably would have reached the value predicted by laboratory analyses if the field test had been run for a much longer period of time. (Knapp-USGS)
W70-04354

HYDROGEOLOGICAL INVESTIGATIONS AND ESTIMATION OF FRESH GROUNDWATER RESOURCES IN COASTAL AREAS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
V. D. Babushkin, and V. M. Goldberg.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 383-389, 1967. 7 p, 1 ref.

Descriptors: *Hydrogeology, *Aquifers, *Coasts, *Saline water-freshwater interfaces, *Surveys, Water resources development, Water management (Applied), Saline water intrusion.
Identifiers: Coastal fresh-water lenses.

The hydrogeological conditions of coastal fresh groundwaters are discussed and characterized schematically. The principles of estimating the exploitation resources of coastal fresh groundwater are given, salt water encroachment is taken into account, and design factors of concentrated and linear water intakes are presented. The problems of hydrogeological investigations, and the techniques of exploration and estimation of fresh groundwater resources in coastal areas are discussed. (Knapp-USGS)
W70-04357

USE OF AIR TO INFLUENCE GROUNDWATER MOVEMENT,
Dames and Moore, San Francisco, Calif.
George D. Roberts.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 390-398, 1967. 9 p, 4 fig, 5 ref.

Descriptors: *Saline water intrusion, *Aquifers, *Coasts, *Groundwater barriers, Groundwater movement, Water management (Applied), Aeration, Saturation, Unsaturated flow.
Identifiers: *Saline water barriers, Air barriers, Saline water intrusion control.

Air may be utilized as a barrier to the migration of saline, or other contaminated waters, where the proper permeability and geologic structure conditions are present. The advantages of an air barrier are: the availability of air, which eliminates the need for pipelines or other means of water conveyance to injection wells; the ease of maintaining the air barrier; and the comparatively low cost of the operations. The great variety of topography, stratigraphy, structural conditions, permeability, and the depth at which the barrier is to be installed and maintained will all have important effects upon the design and operation of such an installation. The well-developed techniques employed to repressurize oil and gas fields, as well as those for the storage of 'off-peak' natural gas in natural underground reservoirs from transmission lines, are reviewed. All who have been afflicted with an air-locked well will attest to the effectiveness of air in decreasing the permeability. Some laboratory data are presented which indicate the effectiveness of air under varying pressures and permeability. (Knapp-USGS)
W70-04358

HYDROGEOLOGICAL STRUCTURES AND WATER RESOURCE REGULARIZATION (IN FRENCH),
For primary bibliographic entry see Field 04B.
W70-04360

GROUNDWATER LEVELS IN NEW MEXICO, 1965, AND CHANGES IN WATER LEVELS, 1961-1965,
Geological Survey, Washington, D.C.
F. E. Busch, and J. D. Hudson.
New Mexico State Engineer, Technical Report 34, 1967. 124 p, 44 fig, 40 tab, 49 ref.

Descriptors: *Water levels, *New Mexico, *Irrigation effects, *Groundwater, *Drawdown, Watersheds (Basins), Water table, Observation wells, Hydrologic data, Monitoring, Data collections.
Identifiers: *Periodic measurements.

Periodic water level measurements in New Mexico are taken in a network of observation wells in areas of heavy groundwater use. There are about 1,500 of these wells in seven major drainage basins or groups of basins. An estimated 90% of all groundwater use in New Mexico is for irrigation. Of the 1,063,000 acres irrigated in the state in 1965, about 587,000 acres were irrigated with groundwater only, 150,000 acres were irrigated with a combination of surface and groundwater, and 326,000 acres were irrigated with surface water only. Extensive groundwater use for irrigation has lowered water levels in most of New Mexico's irrigated areas. This trend continued during the 1961-65 period. The maximum one-year decline in 1965 was 7 feet and the maximum 1961-65 decline was 53 feet. (Carr-Arizona)
W70-04390

QUANTITATIVE ANALYSIS OF WATER RESOURCES IN THE ALBUQUERQUE AREA, NEW MEXICO; COMPUTED EFFECTS ON THE RIO GRANDE OF PUMPAGE OF GROUNDWATER, 1960-2000,
Geological Survey, Washington, D.C.
H. O. Reeder, L. J. Bjorkland, and G. A. Dinwiddie.
New Mexico State Engineer, Technical Report 33, 1967. 34 p, 5 fig, 2 tab, 11 ref.

Descriptors: *Groundwater movement, *Rio Grande, *Drawdown, *Infiltration, *New Mexico, Hydraulic gradient, River flow, Water table, Water demand, Pumping, Hydrogeology, Sedimentation.
Identifiers: *Albuquerque, New Mexico.

Future lowering of water levels in the Albuquerque area was computed from the basic assumptions of water requirements and aquifer characteristics. The greatest decline in water level - 86 feet - is expected to occur under the east mesa. The most significant anticipated effects of this water-level decline are: (1) the reversal of the water-table gradient east of the Rio Grande, causing groundwater to flow away from the river, and (2) the eastward movement of groundwater from the Rio Grande, increasing the quantity of pumped water derived from the river. Roughly 80% of the water pumped by the city in the 1920-1960 period was derived from the flow of the Rio Grande, but development of new wells distant from the river will keep the percentage from increasing. (Carr-Arizona)
W70-04392

HYDROGEOLOGY OF THE RIO GRANDE VALLEY AND ADJACENT INTERMONTANE AREAS OF SOUTHERN NEW MEXICO,
New Mexico State Univ., University Park. Water Resources Research Inst.
For primary bibliographic entry see Field 02A.
W70-04399

HYDROGEOLOGICAL INVESTIGATIONS IN THE WESTERN CATCHMENT OF THE RED SEA,
Geological Survey of Israel, Jerusalem; and Water Planning for Israel Ltd., Tel Aviv.
A. Arad, and A. Michaeli.
Israel Journal of Earth-Sciences, Vol 16, p 181-197, 1967. 10 fig, 2 tab, 11 ref.

Descriptors: *Hydrogeology, *Aquifers, *Groundwater, *Groundwater recharge, *Geology, Precipitation (Atmospheric), Percolation, Sandstones, Watersheds (Basins), Withdrawal, Water balance, Wells, Geochemistry, Water chemistry, Recharge.
Identifiers: *Israel, *Dead Sea Basin, Hydrogeochemistry.

The hydrogeological study evaluates the groundwater balance of the western catchment of the Dead Sea Basin. The 2700 sq km area receives the major portion of its water by percolation from precipitation in the Judean Hills. It also receives some water from rainstorms in the Judean Wilderness. The annual regimal groundwater recharge amounts to between 70 and 100x10 super 6 cm super 3, but exploitation of the Dead Sea Basin aquifers withdraws more water than is replenished. These aquifers rely primarily on the enormous storage in the Lower Cretaceous Nubian Sandstone formation. As a further complication, long-term precipitation records from Jerusalem show a general quantitative decline in rainfall over the past one hundred years. (Carr - Arizona)
W70-04420

2G. Water in Soils

THE VALIDITY OF SOIL-WATER DIFFUSIVITY THEORY FOR HORIZONTAL WATER ABSORPTION,
Purdue Univ., Lafayette, Ind.
David L. Nofziger.
Master of Science Thesis, Purdue Univ, Jan 1970. 67 p, 2 tab, 15 fig, 40 ref. OWRR Project A-010-IND.

Descriptors: *Soil water, Soil physics, *Soil water movement, Permeability, *Diffusivity, Porous media, *Darcy's Law, *Density bulk, *Gamma rays, Absorption.
Identifiers: Particle movement, *Gamma ray attenuation, Water content gradient, Water flux.

The theory of soil-water diffusivity is normally used to describe absorption of water by a horizontal soil column. Deviations from theory have been noted wherein the water-flux increases more than proportional with the water-content gradient. A study was made for possible cause of these deviations. Transient water-content measurements were made by gamma-ray attenuation. A silt loam soil with both low and high bulk densities showed marked deviations from theory for positions near the water-inlet, but decreased with further-distant positions. Since deviations occurred at both soil densities, the possibility of particle rearrangements being the cause was discarded.
W70-04048

STORM RUNOFF FROM FORESTED CATCHMENTS BY SUBSURFACE ROUTES,
Forest Service (USDA), Columbus, Ohio. Northeastern Forest Experiment Station.
R. Z. Whipkey.
Floods and Their Computation, Proceedings of the Leningrad Symposium, Int'l Assoc Sci Hydrology, p 773-779, Aug 1967.

Descriptors: *Subsurface runoff, *Subsurface flow, *Hydrologic properties, *Hydraulic conductivity, Soils, Permeability, Watershed management, Hydraulics, Hydraulic properties, Hydraulic gradient, Soil physical properties, Soil water movement.

Subsurface stormflow (quick interflow) is a major source of high stream stages from wetted, unfrozen forest soils. Field plot and small watershed studies showed greatest quantities of discharge from fine-textured soils and least from coarse-textured soils which have an inherently greater hydraulic conductivity. Large biological channels, structural planes and channels in fine-textured soils were found to be important water-conduction sources, but their overall importance in watershed discharge is not known. Preliminary plot treatments using subsoiling and trenching techniques to break hydraulic continuum of bedding planes and soil channels reduced subsurface stormflow from the wetted regions above the trenches.
W70-04065

AN EXPERIMENTAL STUDY OF THE UPTAKE OF WATER BY SOYBEAN ROOTS,
Illinois Univ., Urbana. Dept. of Agronomy.
For primary bibliographic entry see Field 02D.
W70-04069

THE INFLUENCE OF FREEZING AND THAWING ON SOIL MOISTURE,
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
For primary bibliographic entry see Field 02C.
W70-04112

THE CONTINUITY BETWEEN GROUNDWATER FLOW SYSTEMS AND FLOW IN THE UNSATURATED ZONE,
Department of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Branch.
R. Allan Freeze.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan Univ, Nov 15-16, 1967, p 205-240, 1968. 36 p, 7 fig, 1 tab, 34 ref.

Descriptors: *Groundwater movement, *Saturated flow, *Unsaturated flow, *Soil water movement, Infiltration, Evaporation, Groundwater recharge, Equations, Dimensional analysis, Steady flow, Unsteady flow, Compressible flow, Pressure head, Watersheds (Basins), Water level fluctuations.
Identifiers: *Canada, *Saskatchewan, Good Spirit Lake, Soil water-groundwater relationships.

There is a physical and mathematical continuity between unsaturated flow processes of infiltration and evaporation and saturated processes of groundwater recharge and discharge. A generalized flow equation which describes both saturated and unsaturated flow is derived. From this equation, it is possible to develop the one, two, or three-dimensional forms of the steady or unsteady flow equations for saturated or unsaturated flow of a compressible or incompressible fluid through a nonhomogeneous, anisotropic porous medium. The solutions for one-dimensional, vertical, unsaturated, and unsteady flow are reviewed. A mathematical model was developed to examine the mechanisms which control the continuous moisture flow from the soil surface to a point within the groundwater flow pattern. It is shown that the pressure head, total head, and moisture content profiles in the unsaturated zone are dependent upon the conditions of groundwater recharge and discharge. Water table fluctuations result when the rate of groundwater recharge or discharge is not matched by the rate of infiltration or evaporation in the unsaturated zone. Measurements at a recharge-discharge site in the Good Spirit Lake drainage basin, Saskatchewan, appear to be in accord with the theoretical treatment. (Carstea-USGS)
W70-04113

SOIL MOISTURE - INSTRUMENTATION, MEASUREMENT AND GENERAL PRINCIPLES OF NETWORK DESIGN,
Guelph Univ. (Ontario). Dept. of Soil Science.
K. M. King.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan Univ, Nov 15-16, 1967, p 269-285, 1968. 17 p, 55 ref.

Descriptors: *Soil moisture, *Instrumentation, *Nuclear moisture meters, *Moisture content, *Moisture tension, Infiltration, Runoff, Soil moisture meters, Storage, Evapotranspiration, Soil water movement, Dissolved solids, Groundwater recharge, Analytical techniques, Tensiometers, Gamma rays, Electrical resistance.
Identifiers: Neutron scattering method, Gamma ray attenuation.

Various instruments and techniques may be used to measure the status of water in soil. Several of these are described and evaluated. For inventory purposes, it is necessary to know the change in soil moisture content of the root zone and the flow of water into and out of this zone. The neutron scattering method appears to be the best available for determination of soil moisture content on a network basis. Possible errors in the method are described in detail and suggestions and precautions are given on its use for field measurements. (Carstea-USGS)
W70-04115

APPLICATION OF THERMODYNAMICS TO SOIL MOISTURE,
Saskatchewan Univ. (Saskatoon). Dept. of Soil Science.
E. De Jong.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan Univ, Nov 15-16, 1967, p 25-49, 1968. 25 p, 2 fig, 3 tab, 25 ref.

Descriptors: *Soil moisture, *Thermodynamics, *Thermodynamic behavior, *Soil water movement, Free energy, Capillary water, Surface waters, Entropy, Enthalpy, Equations, Moisture tension.
Identifiers: *Soil water retention curves, Linear phenomenological laws, Onsager's reciprocal relationships.

A brief review is given of the fundamental equations of thermodynamics and the theory is then extended to the retention and movement of water in soils. At equilibrium, the partial molar free energy is the same everywhere and, based on this, a working equation describing the forces of moisture retention is derived. This equation can be used to clarify the principles behind several methods of determining the soil moisture retention curve or determining the capillary potential. If the system is not too far from equilibrium, irreversible thermodynamics, based on the linear phenomenological laws and Onsager's reciprocal relationships, can be used to describe the simultaneous movement of many components. An example of the application of irreversible thermodynamics to fluxes in soils is given and the advantages of this approach over the empirical linear laws are pointed out. (Carstea-USGS)
W70-04117

ON THE STORAGE COEFFICIENT OF FREE SURFACE AQUIFERS, CONSIDERING THE FLOW IN THE UNSATURATED ZONE (FRENCH),
Grenoble Univ. (France).
Georges Vachaud.
English summary included. Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 69-82, 1967. 14 p, 12 fig, 2 tab, 11 ref.

Descriptors: *Specific yield, *Storage coefficient, *Aquifers, Soil water, Permeability, Porosity, Specific retention, Water storage, Water yield, Water level fluctuations, Water table, Unsaturated flow.
Identifiers: Unsaturated zone.

The assumption that specific yield is the volume of water drained from an aquifer when the water table is lowered has no theoretical basis. It neglects flow in the unsaturated zone above the aquifer. During drainage or recharge, the moisture profile above the water table will tend toward a limit given by capillary pressure-moisture content curves. Storage coefficient, the ratio of water yield to volume of soil drained, reaches a constant value after a period of time depending on permeability. Furthermore, the limit is a function of drawdown, and storage is equal to specific yield only for very large drawdown. With equilibrium conditions, the storage coefficient varies, dependent on initial depth of the water table and on drawdown, to a critical depth at which the value of suction is equal to the residual moisture content, and below which the storage coefficient is constant. Values of storage coefficient are plotted against drawdown and initial water table depth for several soils. (Knapp-USGS)
W70-04124

CHANGES IN THE CLAY-WATER SYSTEM WITH DEPTH, TEMPERATURE, AND TIME,
Georgia Inst. of Tech., Atlanta. Water Resources Center.
For primary bibliographic entry see Field 02K.
W70-04295

MEASUREMENT OF ATMOSPHERIC PRESSURE AND SUBSURFACE-GAS PRESSURE IN THE UNSATURATED ZONE OF THE BANDELIER TUFF, LOS ALAMOS, NEW MEXICO,
Geological Survey, Santa Fe, N. Mex.
J. L. Kunkler.
Available from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D283-D287, 1969. 5 p, 7 fig, 2 ref.

Descriptors: *Pressure, *Gases, *Monitoring, *Waste disposal, *Injection wells, Unsaturated flow, Soil water, Soils, Aquifers, New Mexico, Radioactive wastes, Radioactive waste disposal.
Identifiers: Los Alamos (N Mex), Bandelier Tuff, Gas disposal.

Pressure transducers, power supplies, and potentiometric recorders were assembled into portable pressure-monitoring systems which measured pressures in the field with an accuracy of about 0.3%. The performance of some of the components was affected by fluctuations in field temperatures; hence these components were operated in a constant-temperature chamber. Subsurface-gas pressures responded to changes in the atmospheric pressure to depths of 35 meters in the Bandelier Tuff; the response was completely attenuated at some depth between 35 and 89 m. (Knapp-USGS)

W70-04335

DIFFERENCES IN SOIL CHEMISTRY INDUCED BY EVAPORATION AND FLOW OF GROUNDWATER,
Geological Survey, Denver, Colo.
Reuben F. Miller.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D255-D259, 1969. 5 p, 5 fig, 7 ref.

Descriptors: *Water chemistry, *Groundwater, *Surface waters, *Evaporation, *Ion exchange, Groundwater movement, Grasslands, Leaching, Drainage, Runoff, Saline water, Saline water systems, Saline soils, Soil chemistry.
Identifiers: Prairie potholes.

Soil samples from a drainageway between two prairie potholes in North Dakota were analyzed to determine if and how migration of water through and upward from the saturated zone might influence the chemical composition of water flowing from the upper to the lower pond. Water in the unsaturated zone, that apparently achieves capillary equilibrium during the night, subsequently drains back down each day when equilibrium immediately above the water table is disrupted by transpiration. The salinity of water draining back to the water table is apparently increased as a result of transpiration. The proportion of sodium to calcium and magnesium in the water draining back to the water table is increased as a result of ion exchange. These processes produce an increase in both the salinity and proportion of sodium to calcium and magnesium of water arriving at the lower pond from the upper pond. (Knapp-USGS)
W70-04340

PRACTICAL IMPLICATIONS OF WATER REPELLENCY OF SOILS,
Arizona Univ., Tucson. Dept. of Agricultural Chemistry and Soils.
Hasan K. Qashu, and Daniel D. Evans.
Progressive Agriculture in Arizona, Vol 21, No 6, p 3-5, November-December 1969. 3 fig.

Descriptors: *Soil surfaces, *Organic matter, *Surfactants, *Wettability, Soil fungi, Irrigation, Water yield, Mudflows, Soil properties, Citrus fruit, Arizona, Deserts, Orchards.
Identifiers: *Water repellency, *Soil non-wettability, Peat moss.

Water repellency is a surface phenomenon induced by organic chemicals and/or organisms in the soil. Under natural conditions water repellency is caused by one or more of the following: (1) high content of organic matter in surface soil; (2) coating of soil particles by organic chemicals, and (3) high concentration of fungi mycellia. The two major areas of losses due to water repellency problems are probably home gardening and citrus orchards. This is quite often due to incorrect use of peat moss. Another problem area is watersheds that have been burned by wildfire. Water yield is increased, but so is erosion hazard. Mudflows often result. There are several surfactants available to combat water repellency in soils. The buyer should use the following criteria in selecting an appropriate surfactant: (1) efficiency of the chemical in combating water repellency; (2) effective period of the surfactant under local soil and climatic conditions; (3) degradability of the chemical and its residual effects on microbial ecology; and (4) economic and esthetic benefits derived from using the surfactant. More research is needed in the relationship of soil repellency to mechanisms of water transfer in soils. (Carr-Arizona)
W70-04395

SALT AND WATER MOVEMENT INTO SOLONETZIC SOILS,
Department of Agriculture, Lethbridge (Alberta). Research Station.
J. C. van Schaik, and R. R. Cairns.
Canadian Journal of Soil Science, Vol 49, No 2, p 205-210, June 1969.

Descriptors: *Alkaline soils, *Leaching, *Land reclamation, *Infiltration, *Saline water, Arid lands, Water loss, Sodium, Runoff, Evaporation, Ions, Cation adsorption, Capillary action, Penetration, Permeability, Soil horizons.
Identifiers: *Solonetzic soils, Alberta, Canada, Divalent cations.

Water infiltration into an alkaline soil (Duagh silt loam) was greatly increased with the aid of NH sub 4 super plus or divalent cations. An 0.1 N solution penetrated the soil 50 times faster than water. Greatest leaching efficiency occured when the soil was driest. But as long as there is a net annual downward movement of water in the soil, application of cations will cause the sodium to move downward in the soil profile. This treatment could improve penetration of the soil by rainwater and thus reduce runoff and evaporation loss. (Carr-Arizona)
W70-04400

AGRARIAN STRUCTURE IN THE PIEDMONT OASES OF TARAPACA PROVINCE (IN SPANISH),
Universidad Catolica de Valparaiso (Chile). Departamento de Geografia.
For primary bibliographic entry see Field 03F.
W70-04410

HYDROGEOLOGICAL INVESTIGATIONS IN THE WESTERN CATCHMENT OF THE RED SEA,
Geological Survey of Israel, Jerusalem; and Water Planning for Israel Ltd., Tel Aviv.
For primary bibliographic entry see Field 02F.
W70-04420

A STUDY OF CERTAIN PHYSICAL PROPERTIES OF A VERTISOL IN THE GEZIRA AREA, REPUBLIC OF SUDAN,
Food and Agriculture Organization of the United Nations; and Ministry of Agriculture, Wad Medani (Sudan). Soil Survey Div.
A. Zein El Abedine, Glenn H. Robinson, and J. Tyego.
Soil Science, Vol 108, No 5, p 359-366, November 1969. 2 fig, 9 tab, 11 ref.

Descriptors: *Soil physical properties, *Soil types, *Moisture availability, *Hydraulic conductivity, Soil profiles, ARID LANDS, Semiarid climates, Percolation, Seepage, Retention, Particle size, Sodium, Pores, Clays, Density, Soil density probes.
Identifiers: *Vertisols, *Sudan, Exchangable sodium percent (ESP).

The soils of the Gezira area of the Sudanese Central Clay Plain have developed from basaltic parent materials in a semiarid to arid climate. These vertisols, similar to ones in Tanzania and Egypt, are notable for their high water retention. This ranges from 20 to 30% at 15 bars and from 45 to 65% at 0.1 bar. The available moisture levels are positively correlated with the exchangeable sodium percent and range from 45 to 65%, with an average of 21%. The soils have low hydraulic conductivities (from 5 cm/hour to 0.005 cm/hour), with one layer in the profile having relatively much lower conductivity. This appreciably checks the downward passage of water in the soil profile. (Carr - Arizona)
W70-04421

MOISTURE BALANCE IN SOILS OF THE EDMONTON AREA,
Alberta Univ., Edmonton. Soil Science Dept.
T. R. Verma, and J. A. Toogood.
Canadian Journal of Soil Science, Vol 49, p 403-407, October 1969. 3 tab, 10 ref.

Descriptors: *Semiarid climates, *Soil moisture, *Moisture deficit, *Soil types, Soil texture, Evapotranspiration, Storage capacity.
Identifiers: *Moisture balance, Available water capacity, Alberta, Canada.

Due to insufficient precipitation during the growing season, crops of the Canadian Prairies depend heavily on reserve soil moisture. The purpose of the study was to determine the moisture storage capacities of the 22 major soil types in the Edmonton area. The soils were sampled to a depth of 122 cm and found to have available water capacities ranging from 5 to 30 cm. Potential and actual evapotranspiration was estimated and from the data the moisture deficits were determined. Fine-textured soils showed deficits of 2-5.5 cm; medium-textured soils, 3.5-7 cm; and coarse-textured soils, 8-12 cm. Soils with high available water capacity did not show moisture deficits until July or later, but soils with low capacity showed a deficit from the very beginning of the growing season. (Carr - Arizona)
W70-04422

2H. Lakes

PRELIMINARY DETERMINATIONS OF HYDROBIOLOGICAL CONDITIONS IN THE VICINITY OF THE PROPOSED JETPORT AND OTHER AIRPORTS IN SOUTH FLORIDA, JULY 1969,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 04C.
W70-04078

A NUMERICAL STUDY OF LARGE-SCALE MOTIONS IN A TWO-LAYER RECTANGULAR BASIN,
Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
Kenneth B. Yuen.
Manuscript Report Series, No 14, Marine Sciences Branch, Department of Energy, Mines and Resources, Ottawa, 1969. 119 p, 58 fig, 6 tab, 59 ref.

Descriptors: *Great Lakes, *Model studies, *Water circulation, Mathematical models, Winds, Waves (Water), Currents (Water), Lakes, Frequency, Seiches.
Identifiers: Lake circulation.

Large-scale motion in the Great Lakes is predicted through the use of computer-oriented mathematical models. A one-layer one-dimensional model is constructed for Lake Huron. Spatial integration of the hydrodynamical equations by finite-difference techniques yields the frequencies of the lowest longitudinal free barotropic modes of Lake Huron. The power spectral analysis of water level records is carried out to verify these calculated frequencies. A numerical model is constructed for a two-layer rectangular basin of constant depth. The response of the basin under the influence of wind stress is studied. Six cases were investigated, in which the wind stress was impulsive, constant or periodic in time. The behavior of the basin is discussed in terms of theoretical forced and free motions. (Knapp-USGS)
W70-04099

REDUCTION OF ZOOPLANKTON STANDING STOCKS BY PREDACEOUS CYCLOPS BICUSPIDATUS THOMASI IN MARION LAKE, BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Dept. of Zoology; and British Columbia Univ., Vancouver. Inst. of Fisheries.
Donald J. McQueen.
Journal Fisheries Research Board of Canada, Vol 26, No 6, p 1605-1618, 1969. 8 fig, 1 tab, 12 ref.

Descriptors: *Predation, *Standing crop, *Copepods, Feeding rates, Rotifers, Zooplankton, Lakes.
Identifiers: *Marion Lake (British Columbia), Cyclops biscuspidatus, Cladocera, Canada.

Copepodids of stage IV and V and adults of Cyclops biscuspidatus are predators. Predaceous forms appeared in the plankton in April and May, peaked during July and decreased during August of both study years (1966 and 1967). Predaceous forms did not feed on seven forms of algae but did feed on six groups of animals: nauplii I-IV and copepodids I-III of C bicuspidatus, Diaptomus nauplii, Diaptomus copepodids, Cladocera, and rotifers. Laboratory feeding studies yielded high feeding rates of rotifers, Cyclops nauplii and Diaptomus nauplii, and low rates on cladocerans. Studies on predation rates under field conditions showed higher rates for mixtures of Cyclops and Diaptomus nauplii; lower rates for rotifers. Calculations of estimated number of prey eaten (C b nauplii) and surviving prey were 23.9 and 53.4 per liter, respectively; so that 31% of the nauplius production recruited during the summer could have been eaten, assuming feeding rates equal to those of laboratory studies. C b thomasi contributes significantly to mortality of diaptomid nauplii but not to copepodids. (Voightlander-Wisconsin)
W70-04183

PHYTOPLANKTON FROM SWEDISH LAKES. II. LAKE ASSJON 1961-1962,
Uppsala Univ. (Sweden). Inst. of Limnology.
Torbjorn Willen.
Oikos, Vol 20, No 1, p 67-77, 1969. 3 fig, 5 tab, 7 ref.

Descriptors: *Phytoplankton, *Lakes, Chemical analysis, Trophic level, Analysis, Cyanophyta, Chlorophyta, Chrysophyta, Diatoms, Euglenophyta, Pyrrophyta, Temperature, Oxygenation.
Identifiers: *Lake Assjon (Sweden), Peridinae groups, Physical analysis, Phytoplankton volume, Transparency.

This comprehensive qualitative and quantitative investigation of phytoplankton of Lake Assjon, Sweden, embraced an appraisal of about 100 taxonomic groups, including the predominant Chrysophyceae. The study was supplemented by determination of temperature, transparency, pH values, oxygenation, different forms of nitrogen, bases, dissolved and total phosphates, chlorides, sulfates, and carbonic acid. The changes in the volume of phytoplankton of different groups were recorded at monthly or shorter intervals from May 1961 till July 1962. The results of the study were compared with results obtained for Lake Vattern, Lake Sodra Vixen, and several others. The total plankton volume in the studied lakes is usually below five hundred million cubic micron/liter and seldom exceeds one billion cubic micron/liter. (Wilde-Wisconsin)
W70-04185

RELATIONSHIP BETWEEN BACTERIA, NUTRIENTS AND RAINFALL IN SELECTED BODIES OF FRESH WATER,
Florida Inst. of Tech., Melbourne. Univ. Center for Pollution Research.
David D. Woodbridge, and William R. Garrett.
Bulletin of Environmental Contamination and Toxicology, Vol 4, No 5, p 311-319, 1969. 5 fig.

Descriptors: *Bacteria, *Nutrients, *Rainfall, *Fresh water, Lakes, Pollutants, Sampling, Temperature, Dissolved oxygen, Nitrates, Phosphates, Coliforms, Runoff, Chemical properties, Recreation facilities.
Identifiers: Artificial lakes, St Johns River (Fla).

The pollution problem of small, man-made, lakes is increasing. They may act as accumulation points for nutrient material and bacteriological and chemical pollutants. St Johns River, Florida, a natural drainage for a large watershed, was selected as control for this study. Selection of two small lakes was based upon conditions existing in adjacent land areas. One, located in a wooded area, about 1/4 mile from the nearest dwelling; the second, encompassed by a housing development and by business establishments. Canals flow through the housing development into the lake. Analyses were made for dissolved oxygen, nitrate nitrogen, ortho phosphate, and bacteria. Results indicate that relationship between dissolved nutrients such as phosphate and nitrate and indicator bacteria (total coliform) are not simple or direct. Variability in data with time and different bodies of water raises doubts regarding the direct relationship between chemical and bacterial pollutants. Sharp increases in total coliform occurred in both lakes unrelated to rainfall. Total coliform in St Johns River correlate much closer to rainfall; even there several sharp increases in total coliform count occurred not obviously related to rainfall increase. (Jones-Wisconsin)
W70-04189

WHAT'S KILLING OUR LAKES,
Minnesota Univ., Minneapolis. Dept. Soil Science.
Lowell D. Hanson, and William E. Fenster.
Crops and Soils, Vol 22, p 13-15, 1969.

Descriptors: *Lakes, Streams, Fish, Land, Ecosystems, Eutrophication, Oligotrophy, Sewage, Algae, Scum, Weeds, Nutrients, Septic tanks, Effluents, Swamps, Forest soils, Minnesota, Wisconsin, Michigan, Phosphorus, Agricultural watersheds, Organic matter, Sediments, Fertilizers, Water pollution, Snow, Runoff, Drainage water, Grasslands, Soil erosion, Groundwater, Potholes.
Identifiers: *Killing, Animal manures, Lake Minnetonka (Minn), Soil minerals, Plant residues, Morris (Minn), Soil percolation.

Phosphorus sources from agricultural watersheds are soil minerals and organic matter; fertilizers, manures, and plant residues; sewage and sediment. If soil reacts with phosphorus-containing materials, seeping water will be stripped of phosphorus. Snow-melt carries higher amounts of phosphorus than runoff waters during other seasons. Septic tank waste water does not always evaporate as expected and seeps into groundwater and lakes. Bottom sediments serve as a 'phosphorus sink' reducing the explosive biological effects of phosphorus in water. Solution of environmental problems may involve extensive land-forming operations to force soil filtration of runoff water. Immediate improvements can be effected by not spreading manure on sloping frozen land, diverting feedlot and grain storage runoff into seepage areas, and storing manure in areas where runoff is not a problem; large feed lots should be located on level, fine textured soils rather than shoreline slopes of a stream or lake. Location decisions in agriculture will increasingly be guided by pollution control agency regulations and zoning restrictions. Land use planning has long range consequences. Cooperation of soil scientists, agricultural engineers, and farmers' innovative talents will result in quicker solutions. (Jones-Wisconsin)
W70-04193

THE UPTAKE OF ORGANIC SOLUTES IN LAKE WATER,
Uppsala Univ. (Sweden). Inst. of Limnology.
Richard T. Wright, and John E. Hobbie.
Limnology and Oceanography, Vol 10, No 1, p 22-28, Jan 1965. 3 fig, 3 tab, 15 ref.

Descriptors: *Lakes, *Organic matter, *Physiological ecology, Radioactivity techniques, Analytical techniques, Water pollution effects, Phytoplankton, Diffusion, Algae, Bacteria, Eutrophication, Glucose, Carbon radioisotopes, Dinoflagellates, Bioassay, Bioindicators.
Identifiers: *Heterotrophy, *Biological uptake, *Microbial ecology, Maximum uptake velocity, Active transport, Bacterial populations, Algal populations, Heterotrophic potential, Relative heterotrophic potential, Sweden, Enzyme kinetics, Lineweaver-Burk equation, Michaelis kinetics, Flagellates, Lake Erken (Sweden), Acetate, Lake Norrviken (Sweden), Acetate bacteria, Glucose bacteria, Chlamydomonads.

Methods exist for estimating, with radiocarbon (C-14) labelled organic compounds, their assimilation by planktonic microbiota. Based on Lineweaver-Burk modification of Michaelis enzyme kinetics, a modification of those methods is described which gives better estimates of heterotrophic potential, particularly in cases where uptake is mediated via processes of active transport. The treatment yields a linear relationship such that a plot of the expression, (C) (u) (t)/c, versus A has a slope whose inverse estimates maximum uptake velocity (where: C- counts/minute from 1 microcurie C-14 in counting device; u- microcuries added to sample; t- incubation time (hours); c- counts/minute from filtered organisms; A- milligrams/liter of added substrate). Where uptake results from diffusion into cell with instantaneous metabolism of substrate, a diffusion constant can be defined from knowledge of uptake velocities at two different substrate concentrations. Method was tested in two Swedish lakes subject to eutrophication. Over a wide range of substrates, estimates apparently show existence of two uptake mechanisms: a transport system, saturated at low substrate concentrations, and a diffusion process whose velocity increases steadily with increasing substrate. Evidence suggests that bacterial populations are responsible for 'transport-type' phenomena, and algal populations, for uptake by diffusion. (Eichhorn-Wisconsin)
W70-04194

NITROGEN METABOLISM IN LAKES. III. TRACER STUDIES OF THE ASSIMILATION OF INORGANIC NITROGEN SOURCES,
Pittsburgh Univ., Pa. Dept. of Biological Sciences.
Vera A. Dugdale, and Richard C. Dugdale.
Limnology and Oceanography, Vol 10, p 53-57, 1965. 4 fig, 8 ref.

Descriptors: *Lakes, *Nitrogen cycle, *Metabolism, *Tracers, Stable isotopes, Nitrogen compounds, Cycling nutrients, Pennsylvania, Phytoplankton, Water chemistry, Spectrophotometry, Chlorophyll, Nitrogen fixation, Water pollution sources, Water pollution effects, Phosphates, Chlorophyta, Chrysophyta, Cyanophyta, Diatoms, Eutrophication, Analytical techniques, Ammonium compounds, Nitrates.
Identifiers: *Nitrogen (Inorganic), Nitrogen-15, Millipore filtration, Kjeldahl technique, Nitrogen (Nitrate), Nitrogen (Ammonia), Isotope ratios, Sanctuary Lake (Pa), Coleman nitrogen analyzer, Seasonal effects, Mass spectrometry, Chlorophyll a, Nitrogen (Molecular), Linesville Creek (Pa), Phosphorus (Phosphate), Ammonium sulfate, Potassium nitrate.

Introduction of ammonium sulfate and potassium nitrate labeled with heavy nitrogen (N-15) into lake water samples permitted measurement of uptake rates of these nitrogen (N) sources in Sanctuary Lake, Pennsylvania, during a summer. Isotope ratios (N-15/N-14) of particulates, filtered from samples after short incubation periods with labeled compounds, were determined by mass spectrometry. In addition, fixation rates of molecular N-15 in such samples were estimated by techniques previously described and utilized in limnological studies. Fixation rates were compared with concentrations of inorganic N found in surface waters of the lake. Extensive variations in uptake regime observed during the season were probably associated with seasonal changes in the phytoplankton community. In early summer, all three forms (ammonia-N, nitrate-N, molecular N) were taken up rapidly, whereas a second pulse of uptake in late summer consisted predominantly of assimilated molecular N. Availability of N compounds in ambient water apparently does not control uptake in Sanctuary Lake, since all forms were present throughout summer, ammonia-N being most abundant, with concentrations in the range 34-300 micrograms/liter. In natural situations, ammonia-N apparently does not suppress N fixation, but may enhance it. (Eichhorn-Wisconsin)
W70-04196

ASPECTS OF THE LIMNOLOGY OF AN ENDORHEIC AFRICAN LAKE (L CHILWA, MALAWI),
Malawi Univ., Limbe.
Brian Moss, and Joyce Moss.
Ecology, Vol 50, No 1, p 109-118, 1969. 3 fig, 7 tab, 35 ref.

Descriptors: *Lakes, *Rainfall, Salinity, Turbidity, Temperature, Phytoplankton, Algae, Diatoms, Nitrates, Phosphates, Fish, Fish harvest.
Identifiers: *Lake Chilwa (Africa), Lake dynamics, Dry lakes, Eu-phytoplankton, Epipelic algae, Endorheic lakes, Africa, Malawi, Arthrospira platensis, Nitzschia palea, Anomoeoneis sphaerophora, Oscillatoria.

Depending on rainfall distribution, Lake Chilwa, Nyassaland, is subject to wide variations in its water volume and length of shoreline. These alterations are accompanied by corresponding great changes in conductance, concentration of chemical constituents, turbidity, and other water properties. The chemical composition of the lake is further complicated by inflow of salt springs and occasional flooding of the marginal mud flats. In dry periods, plant life of the lake is largely limited to epipelic algae; eu-phytoplankton is present only during a few weeks of the year. At times of high water level, the lake is nearly free from nitrates and inorganic phosphates. Regardless of this, large population of digestible diatoms persists on the sediment surface and fish production is high; in 1964 it was expressed in the annual catch of nearly 10,000 metric tons of merchantable fish. Since 1965 increase in salinity, turbidity, and temperature reduced the fish harvest to almost zero. (Wilde-Wisconsin)
W70-04252

A STUDY OF THE PROFUNDAL BOTTOM FAUNA OF LAKE WASHINGTON,
Washington Univ., Seattle. Dept. of Zoology.
Rudolph N. Thut.
Ecological Monographs, Vol 39, No 1, p 79-110, 1969. 27 fig, 5 tab, 34 ref.

Descriptors: *Benthic fauna, Nitrogen, Phosphorus, Phytoplankton, Diatoms, Zooplankton, Dinoflagellates, Algae, Dissolved oxygen, Hypolimnion, Epilimnion, Lake Erie, Insects, Diptera, Crustacea, Molluscs, Oligochaetes, Gastropods.
Identifiers: *Lake Washington (Wash), Macrofauna, Gyttja, Oscillatoria rubescens, Zurichsee, Filamentous algae, Filamentous blue-green algae, Ocular micrometer, Sucrose-flotation technique, Metalimnion, Bathythermograph, Arthropoda, Chironomidae, Aquatic Oligochaetes.

A review of the macrofauna in the profundal zone of Lake Washington between September 1963 and September 1964 and discussion. Although sewage diversion began in 1963, phosphate and oxygen values indicated the lake was still in the eutrophic phase. Ten stations were chosen at 5-meter depth intervals from 10 to 55 meters and sampled approximately monthly with an Ekman dredge. 24 species were recognized from the profundal zone, each presented separately, with the exception of Oligochacta species, along with their depth and population dynamics throughout the year. The Chironomidae were most numerous of bottom fauna constituents (about 45% of the total). 13 species were found during the study, including predators, deposit-feeders, and filter-feeders. Larvae were most common at the shallow-water stations and became progressively diminished with increase in depth. The Oligochaeta comprised about 1/2 of the total number and 1/3 of the total biomass of the profundal fauna. Four species were identified. The Oligochaeta were found in the greatest numbers and biomass at the greatest depth sampled; their abundance progressively declined with decrease in depth. Amphipoda and Sphaeridae were present but in smaller numbers. (Haskins-Wisconsin)
W70-04253

DIAGNOSING POLLUTION IN LAKE MINNETONKA,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 05C.
W70-04268

STUDY OF BACTERIA ASSOCIATED WITH MARINE ALGAE IN CULTURE. I. PRELIMINARY DETERMINATION OF SPECIES (FRENCH),
Station Marine d'Endoume, Marseille (France).
B. R. Berland, M. G. Bianchi, and S. Y. Maestrini.
Marine Biology, Vol 2, No 4, p 350-355, 1969. 3 tab, 12 ref.

Descriptors: *Bacteria, *Marine algae, *Cultures, Pseudomonas, Metabolism, Kinetics, Nitrogen compounds.
Identifiers: Species determination, Taxonomy, Flavobacterium, Achromobacter, Gulf of Marseilles, Asterionella japonica, Chaetoceros launderi, Lauderia borealis, Leptocylindrus danicus, Phaeodactylum tricornutum, Stichochrysis immobilis, Vibrio, Morphology, Cultural characteristics, Ternary compounds, Macromolecules, Antibiotics, Agarbacterium, Xanthomonas, Micrococcus, Staphylococcus.

Bacteria strains have been isolated from marine algae cultures and assigned tentative genera and species. Observations and tests were conducted using Bergey's manual and specific papers on marine bacteria as taxonomic keys. The genera Pseudomonas, Flavobacterium, and Achromobacter appear most important, based on the number of species. This does not imply that they actually dominate in number of germs and in metabolic importance. A later study will permit determination of the precise nature and division of species which accompany an alga in culture and subsequently the same alga in its natural environment. It may be necessary to use some culture medium more definitive and less plethoric, the medium currently used being too rich in organic matter and not corresponding to conditions of the natural medium of the organisms; the literature shows that their nutritional needs are very simple. The study is undertaken to determine precisely their metabolic needs and how these are satisfied in a culture of algae. (Jones-Wisconsin)
W70-04280

COMPETITION BETWEEN PLANKTONIC BACTERIA AND ALGAE FOR ORGANIC SOLUTES,
Uppsala Univ. (Sweden). Inst. of Limnology.
John E. Hobbie, and Richard T. Wright.
Memorie dell'Instituto Italiano di Idrobiologia, Suppl 18, p 175-185, 1965. 4 fig, 1 tab, 5 ref.

Descriptors: *Competition, *Phytoplankton, *Aquatic bacteria, *Algae, Organic matter, Lakes, Diffusion, Carbon radioisotopes, Chlamydomonas, Bioassays, Water pollution effects, Analytical techniques.
Identifiers: *Organic solutes, *Heterotrophy, Microbial ecology, Sweden, Lake Erken (Sweden), Active transport, Carbon-14, Enzyme kinetics, Glucose, Mechaelis-Menten equation, Acetate, Glycollic acid.

Sophisticated investigative techniques, in addition to the traditional methods of direct counts and enrichment cultures, are required for better understanding of roles of microorganisms in the dynamics of lacustrine metabolism. A problem of current interest is the identification of organic solutes utilized by heterotrophic bacteria and algae, and estimation of their concentrations and uptake rates. Data on assimilation of radiocarbon-labeled organic substrates can be analyzed on bases of theories of diffusion and enzyme kinetics. Such methods are illustrated with data from studies on model cultures (Chlamydomonas and planktonic bacteria) and samples from Lake Erken (Sweden). Measurements of velocity uptake of radioisotope over a range of substrate concentrations reveal two mechanisms: an active transport system, attributable to bacteria, and another system in algae which follows diffusion kinetics. The latter is effective at substrate concentrations above 500 micrograms/liter. In natural waters, bacteria effectively reduce acetate and glucose concentrations below 20 micrograms/liter, apparently effecting drastic limitation of algal heterotrophy. In nature, other compounds are available to algae and higher temperature may increase uptake rates, so that algal heterotrophy is not necessarily precluded. (Eichhorn-Wisconsin)
W70-04284

A NEW METHOD FOR THE STUDY OF BACTERIA IN LAKES: DESCRIPTION AND RESULTS,
North Carolina State Univ., Raleigh. Dept. of Zoology; and Gordon Coll., Wenham, Mass.
John E. Hobbie, and Richard T. Wright.
Mitteilungen Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 14, p 64-71, 1968. 5 fig, 10 ref.

Descriptors: *Lakes, *Bacteria, *Analytical techniques, Water pollution effects, Algae, Ecosystems, Physiological ecology, Aquatic bacteria, Carbon radioisotopes, Enzymes, Kinetics, Photosynthesis, Organic matter, Organic compounds, Metabolism, Bioindicators, Bioassays.
Identifiers: *Heterotrophy, Autotrophy, Carbon-14, Radiocarbon uptake techniques, Glucose, Michaelis-Menten equation, Sweden, Lake Erken (Sweden), Lineweaver-Burk equation, Maximum uptake velocity, Michaelis constant, Lake Norrviken (Sweden), Lake Ekoln (Sweden), Lake Lotsjon (Sweden), Permeases, Chamydomonads, Lappland (Sweden), Acetate, Turnover times.

Although bacteria are important in lacustrine metabolism, details of their population dynamics--including generation times and turnover rates--are poorly understood. Radiocarbon-labeled organic compounds have been used previously to determine heterotrophic potential of natural waters, but concentrations of substrate added have been sufficiently large as to make interpretation of resultant data ambiguous. Based upon theoretical treatment adapted from Lineweaver-Burk modification of Michaelis-Menten enzyme kinetics, and on additions of very low concentrations of labeled organic substrates, a new method for study of bacterial assimilation is described. That derivation yields relationship, $t/f = (K + S)/V) + A/V$. Here, t is incubation time (hours); f, percentage uptake of isotope by organisms; K, constant (similar to Michaelis constant); s, substrate concentration in nature; A, added substrate concentration; V, maximum velocity. Plot of t/f versus A usually results in linear relationship from which can be estimated maximum uptake velocity (V), turnover time, and approximate naturally occurring substrate concentration. Method is illustrated with data from a series of Swedish lakes. During a single year, V may vary by 2 orders of magnitude within one lake; by 4, between lakes. V is also a very sensitive indicator of pollution. (Eichhorn-Wisconsin)
W70-04287

ANNUAL AUTOTROPHIC PRODUCTION OF PHYTOPLANKTON IN LAKE BAIKAL,
K. K. Votintsev, and G. I. Popovskaya.
Translated from Russian. Original p 205-208. Doklady Akademii Nauk SSSR, Vol 176, No 1, p 634-637, 1967. 3 fig, 1 tab, 13 ref.

Descriptors: *Phytoplankton, *Lakes, Organic matter, Seasonal, Algae, Primary productivity, Harvesting of algae, Biomass.
Identifiers: Seasonal distribution, Lake Baikal, Photosynthetic layer, Melosira baicalensis, Gymnodinium baicalense, Cyclotella minuta.

This pioneering survey of organic matter production in Lake Baikal disclosed a wide place-and-time variation in the biomass of phytoplankton, represented largely by Melosira baicalensis,

Cyclotella minuta, and Gymnodinium baicalense. According to preliminary estimates, the lake has an annual productivity of 157 million tons (wet weight) of harvestable algae, and 136 million tons of non-harvestable algae. The study of primary productivity by the 'flask' method, using oxygen, was confined to the upper 25 meters of the photosynthetic layer. The mean annual biomass per surface square meter of this layer approached 7 grams. The ratio of the average annual primary production to the mean annual index of phytoplankton biomass for the entire lake was equal to 464. Previous studies have shown that values for gross photosynthesis are close to those permitting effective productivity of algae. Information on food requirements of main representatives of zooplankton of Lake Baikal thus far is not available. (Wilde-Wisconsin)
W70-04290

SEASONAL CHANGES IN THE LIMNOLOGY OF SOME MEROMICTIC LAKES IN SOUTHERN BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Inst. of Fisheries.
T. G. Northcote, and T. G. Halsey.
Journal Fisheries Research Board of Canada, Vol 26, No 7, p 1763-1787, 1969. 9 fig, 7 tab, 32 ref.

Descriptors: *Seasonal, *Limnology, *Meromixis, *Lakes, Dissolved solids, Density, Chemical properties, Temperature, Ice, Profiles, Dissolved oxygen, Hydrogen ion concentration, Alkalinity, Physicochemical properties, Biological properties, Conductivity, Sulfur bacteria, Sampling, Frequency, Phytoplankton, Zooplankton, Benthos, Light penetration, Hydrogen sulfide, Surfaces, Copepods, Crustaceans, Standing crop, Depth, Rainbow trout, Dissolved solids, Lakes.
Identifiers: *British Columbia, Chemocline, Vertical, Plates, Morphometry, Geographic features, Bottom, Mixolimnion, Monimolimnion, Diatomus connexus, Ceriodaphnia lacustris, Brachionus plicatilis, Keratella, Campylodiscus, Oedoginium, Cladocerans, Transparency, Meromictic lakes.

Seasonal changes in physical, chemical, and biological features are described in four small British Columbia lakes showing different types and degrees of meromixis. A wide range exists in total dissolved solid content between lakes and within specific lakes (surface to near-bottom, in milligrams/liter): Yellow, surface 282, bottom 337; White, 6229-7918; Mahoney, 10,003-86,906; Lyons, 12,116-222,195, but no marked seasonal changes. Yellow Lake meromixis is probably maintained by morphometric features of the lake basin rather than strong chemocline; in the other lakes complete mixing is inhibited by chemical density gradients, those in Mahoney and Lyons being especially sharp. Summer, autumn, winter (under ice), and spring vertical profiles are presented for temperature, dissolved oxygen, pH, alkalinity, specific conductivity, and differences discussed. Lesser detailed physical-chemical characteristics are given. Purple sulphur bacteria occur in Lakes White, Mahoney and Lyons and in the latter two from discrete 'plates' detectable by high frequency echo sounding (confirmed by sampling). Seasonal changes in depth of bacterial plates are considered in relation to some physical and chemical parameters. Phytoplankton, zooplankton, and benthos communities are discussed, based on degree of meromixis shown by the lakes. (Jones-Wisconsin)
W70-04294

ISOTOPIC COMPOSITION AND ORIGIN OF THE ATMOSPHERIC WATER VAPOR IN THE REGION OF LAKE LEMAN (IN FRENCH),
Pisa Univ. (Italy). Lab. of Nuclear Geology.
For primary bibliographic entry see Field 02K.
W70-04304

HETEROTROPHIC BACTERIA IN LAKE MALAREN AND LAKE HJALMAREN,
Uppsala Univ. (Sweden). Inst. of Limnology.
R. Fonden.
Oikos, Vol 20, No 3, p 344-372, 1969. 23 fig, 5 tab, 36 ref.

Descriptors: *Bacteria, Seasonal, Sampling, Coliforms, Depth, Surfaces, Ice, Chlorophyll, Phosphorus, Nitrogen, Zooplankton, Organic matter, Phytoplankton, Primary productivity, Chemical analysis, Conductivity, Temperature, Stratification, Population, Sewage, Industrial wastes, Oxygen, Hypolimnion, Epilimnion, Optical properties, Carbon radioisotopes, Meteorological data, Outlets, Detritus, Density, Daphnia, Grazing, Standing crop, Effluents, Filtration, Fluorescence, Eutrophication, Oligotrophy.
Identifiers: *Coliformic bacteria, *Heterotrophic, *Lake Malaren (Sweden), Lake Hjalmaren (Sweden), YPA-bacteria, Vertical distribution, Horizontal distribution, MPA-bacteria, Chromogens, Morphometric, Transparency, Metalimnion, Holomictic, Escherichia coli, Aerobacter aerogenes, Cyclops, Bosmina, Eudiaptomus, Excretion, Filter-feeding, Transported bacteria.

Vertical, horizontal and seasonal variations of YPA-bacteria in Lakes Malaren and Hjalmaren were investigated. Weekly samples were analyzed for coliformic, MPA- and YPA-bacteria. During summer stratification, highest numbers of YPA-bacteria occurred at 0.5 meters; decreasing at 5 meters and greater depths. No significant differences in vertical distribution of YPA-bacteria were detected in the hypolimnion. Highest bacterial densities were found near towns; lowest at lake centers. Positive correlation was found between UPA-bacterial numbers from surfaces and concentration of chlorophyll a, phosphorus, and nitrogen. Negative correlation was found between bacterial density and depth of water column. Bacteria was prolific in June in Lake Marlaren. During spring and autumn, sampling stations near river outflows showed high and maximal numbers of coliformic and MPA-bacteria in Ekoln Basin. In winter, numbers were low at most stations as were numbers of washed-in bacteria. During summer, density of UPA-bacteria were apparently influenced by filter feeding zooplankton and amount of available organic carbon. Bacterial maxima recorded during summer using a nutrient-poor yeast-extract peptone medium were not recorded on ordinary nutrient agar. Proportion of pigmented bacteria was greatest at the surface during summer, and lowest during winter. (Jones-Wisconsin)
W70-04370

USE OF GLUCOSE AND ACETATE BY BACTERIA AND ALGAE IN AQUATIC ECOSYSTEMS,
Uppsala Univ. (Sweden). Inst. of Limnology.
Richard T. Wright, and John E. Hobbie.
Ecology, Vol 47, No 3, p 447-464, 1966. 10 fig, 3 tab, 45 ref.

Descriptors: *Aquatic bacteria, *Algae, *Ecosystems, Phytoplankton, Lakes, Competition, Organic matter, Diffusion, Cyanophyta, Bioassays, Chlamydomonas, Water pollution, Analytical techniques, Amino acids, Eutrophication, Seston, Diatoms.
Identifiers: *Glucose, *Acetate, *Heterotrophy, Microbial ecology, Carbon-14, Sweden, Lake Erken (Sweden), Active transport, Enzyme kinetics, Michaelis-Menten equation, Lineweaver-Burk equation, Sugars, Fatty acids, Bacterium EY-19, Uptake velocity, Pseudomonas, Bacterium ER-19, Gymodinium inversum, Utermohl technique, Radiocarbon uptake technique, Chlorophyll a, Michaelis constant, Maximum velocity, Transport constant, Turnover time, Lake Norrviken (Sweden), Lake Lotsjon (Sweden), Lake Ekoln (Sweden).

Kinetic analysis of phytoplankton uptake of radiocarbon-labeled organic solutes yields useful information about dynamics of microbial ecology. Tests over wide substrate ranges indicate existence of two uptake mechanisms. Data from differential filtration and experiments with model laboratory cultures of bacteria and algae differentiate between specific transport systems, effective at very low substrate concentrations, attributable to bacteria, and diffusion mechanisms, effective at greater substrate concentrations, operative in algae. Proper treatment of data yields estimates of following kinetic parameters which have ecological significance: maximum velocity of uptake by bacteria, giving information on sizes and functions of their populations; diffusion constant, relating to rate of solute uptake by algae; and turnover times of organic solutes in aquatic environments. Turnover times of glucose and acetate in eutrophic Lake Erken, Sweden, indicates that algal uptake never exceeds 10% of bacterial, although algal biomasses may greatly exceed bacterial. Two new bioassays can employ kinetics of bacterial uptake to measure naturally occurring concentrations of substrates. Acetate and glucose remain at relatively constant levels of 1-10 micrograms/liter in several aquatic habitats. It is postulated that bacteria effectively utilize substrate at these low levels, and thus, prevent heterotrophic growth of algae. (Eichhorn-Wisconsin)
W70-04372

SEASONAL TRENDS IN PHYSICOCHEMICAL FACTORS AND PLANKTON OF A FRESH-WATER FISHPOND AND THEIR ROLE IN FISH CULTURE,
Madurai Univ. (India) Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-04376

PRIMARY PRODUCTION AND NUTRIENTS IN OGAC LAKE, A LANDLOCKED FIORD ON BAFFIN ISLAND,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
Ian A. McLaren.
Journal Fisheries Research Board of Canada, Vol 26, No 6, p 1561-1576, 1969. 9 fig, 1 tab, 6 ref.

Descriptors: *Primary productivity, *Zooplankton, *Fertilizers, Chlorophyll, Oxygen, Stratification, Fresh water, Analytical techniques, Analysis, Fjords, Nutrients.
Identifiers: *Holocline, Carbon-14, Baffin Island (Canada), Fertilizer trials, Ogac Lake (Canada).

This study was concerned with the effect of fertilization on primary production and zooplankton of Ogac Lake, Canada. To raise concentration of phosphorus and nitrate nitrogen, known amounts of potassium nitrate and diacid potassium phosphate were added to 3 meter-long and 1 meter-diameter polyethylene columns suspended in the middle of the lake between the anoxic and oxygenated layers. Analyses included determination of chlorophyll, phosphorus, nitrite, nitrate, and carbon-14 uptake. The effect of fertilization was expressed in fivefold increase in amount of chlorophyll and in sevenfold increase in primary production. This improvement took place regardless of the fact that some amount of fertilizers was lost by sinking in particulate form, an unavoidable result in highly stratified lakes. Zooplankton grazing was concentrated at the holocline and deep water and apparently had little influence on the production pattern of the lake. In summer, inflow of fresh water into the narrow zone of Ficus at 2-3 meters killed much of the fauna, thereby augmenting the supply of nutrients. (Wilde-Wisconsin)
W70-04446

EFFECTS OF CONTROLLED NUTRIENT DILUTION OF A EUTROPHIC LAKE,
Seattle, Wash.
For primary bibliographic entry see Field 05C.
W70-04451

FOOD OF LAKE TROUT IN LAKE TAHOE,
Nevada Fish and Game Dept., Reno; and California State Dept. of Fish and Game, Sacramento. Inland Fisheries Branch.
Ted C. Frantz, and Almo J. Cordone.

California Fish and Game, Vol 56, No 1, p 21-35, 1970. 8 tab, 30 ref.

Descriptors: *Fish, *Food habits, *Fish diets, *Lake trout, Sculpins, Fish food organisms, California, Nevada, Amphipoda, Crayfish, Daphnia, Insects, Larvae, Oligochaetes.
Identifiers: *Lake Tahoe (Calif), Cladocera, Ostracoda, Plecoptera, Tenipedae.

Stomachs of 1389 lake trout of five size groups were analyzed. Samples were obtained by creel census, gill-net and bottom trawl. Percentage of empty stomachs increased directly with fork length of fish. Fish under 5 inches utilized cladocerans and copepods (over 90% by weight and frequency of occurrence); tendipid larvae and pupae were of secondary importance. Fish (sculpin) became an important dietary component in fish 5 to 9.9 inches; cladocerans and tendipeds were of secondary importance and amphipods assumed importance. Fish and cladocerans remained important in fish 10 to 14.9 inches, fish other than sculpins and including small lake trout were ingested. Sculpins dominated diet of fish 15 to 19.9 inches; importance of cladocerans diminished while importance of crayfish increased. Fish over 19.9 inches relied almost entirely on fish, primarily suckers. Percentage of stomachs containing food was highest in spring and summer, lowest in winter and autumn for all size groups; mean weight of food per stomach was also highest in spring and summer. Fish were utilized most in spring months, least in summer. Tabular data include seasonal stomach analyses by size group of lake trout. (Voigtlander-Wisconsin)
W70-04452

THE FUTURE OF THE LAKE,
Washington Univ., Seattle. Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-04455

THE DEVELOPMENTAL HISTORY OF BLELHAM TARN (ENGLAND) AS SHOWN BY ANIMAL MICROFOSSILS, WITH SPECIAL REFERENCE TO THE CLADOCERA,
Indiana Univ., Bloomington. Dept. of Zoology.
Rodney V. Harmsworth.
Ecological Monographs, Vol 38, No 2, p 223-241, 1968. 9 fig, 4 tab, 91 ref.

Descriptors: *History, *Animals, *Microorganisms, Midges, Sediments, Pollen, Paleolimnology, Bogs, Peat, Glaciers, Organic matter, Temperature, Indicators, Cyanophyta, Oligotrophy, Eutrophication, Zooplankton, Phytoplankton, Chemical analysis, Daphnia, Stratigraphy, Mud, Clays, Littoral, Arctic, Sub-arctic, Temperate, Humic acids, Rotifers, Copepods.
Identifiers: *Microfossils, *Cladocera, *Blelham Tarn (England), Neorhabdocoeles, Bythotrephes, Lake Windermere (England), Chydoridae, Sida, Bosminidae, Bosmina coregoni, Bosmina longirostris, Tanytarsus, Sergentia, Chironomus, Polyphemus, Crooked Lake (Ind), Madison (Wis), Egg-capsules, Ceriodaphnia, Sphagnum, Chydorus sphaericus, Chydorus ovalis, Leptodora, Acroperus harpae, Esthwaite Water (England), Tuberculate Cladocera.

Two cores were taken from Blelham Tarn, 'A,' from a peat bog containing both Lateand Post-glacial sediments, and, 'B,' from deep water containing only Post-glacial sediments. The Cladocera were analyzed qualitatively and quantitatively. Nine species of non-chydorid Cladocera and 24 species of Chydoridae were found. In 'A' two marked periods of abundance occurred in the Allerod and in the Preboreal, with few remains in the Older and Younger Dryas. Periods of abundance coincided with maxima in organic sediment content, and higher temperatures as deduced from stratigraphic distribution of chydorids. Few remains were found in upper peat section of 'A,' but distribution gave evidence of periodic lake level changes. 'B' showed marked changes in abundance of planktonic community, presumably correlated with changes occurring in the peat section of 'A.' Typological succession was followed in the Post-glacial by means of indicator organisms, especially Bosmina coregoni, which gave way to B longirostris in Sub-atlantic period. Midges were analyzed in 'B' and replacement of a predominantly Tanytarsus-Sergentia community by Chironomus occurred shortly before the change-over in the Bosmina species. The neorhabdocoeles, egg-capsules well preserved in lake sediments, are described. Their stratigraphy showed no obvious relationship to other lake events. (Jones-Wisconsin)
W70-04459

PRODUCTIVITY OF OWIKENO LAKE, BRITISH COLUMBIA,
Fisheries Research Board, Nanaimo (British Columbia). Biological Station.
David W. Narver.
Journal Fisheries Research Board of Canada, Vol 26, No 5, p 1363-1368, 1969. 2 tab, 9 ref.

Descriptors: *Primary productivity, *Fish, *Salmon, *Growth rates, *Food chains, Radioactivity technique, Dissolved solids.
Identifiers: Owikeno Lake (British Columbia), British Columbia, Canada, Sockeye salmon, Chlorophyll a, Fish production, Lake Chignik (Alaska), Lake Karluk (Alaska), Lake Igushik (Alaska), Black Lake (Alaska), Babine Lake (British Columbia).

Primary production was measured at two stations on two dates in Owikeno Lake, British Columbia. Mean carbon assimilated per 4 hours was 11 milligrams/square meter (range 2.57 to 30.23) and 1.8 milligrams/cubic meter (range 0.62 to 3.33). Mean chlorophyll a was 0.9 milligrams/cubic meter (range 0.27 to 1.34). Measurements of assimilated carbon were higher in June, chlorophyll a was greater in September. Owikeno has a low primary production rate compared with other major sockeye-producing lakes; probable factors involved include high turbidity and low total dissolved solids. Significance of primary productivity measurements relative to rearing capacity of lake for juvenile sockeye is unknown, but slow growth rate of juveniles may be due to retarded rate of energy transfer through the phytoplankton-zooplankton-sockeye food chain. Tabular data include all measurements in Owikeno Lake and comparison of salmon returns and productivity measurements for six lakes, including Owikeno. (Voigtlander-Wisconsin)
W70-04464

OUTWITTING THE PATIENT ASSASSIN: THE HUMAN USE OF LAKE POLLUTION,
Northwestern Univ., Evanston, Ill. Technological Inst.
For primary bibliographic entry see Field 05C.
W70-04465

DEVELOPMENT OF A MATHEMATICAL MODEL FOR PREDICTION OF TEMPERATURE IN DEEP RESERVOIRS-PHASE II: HIGH DISCHARGE-VOLUME RATIO RESERVOIRS,
Water Resources Engineers, Inc., Lafayette, Calif.
For primary bibliographic entry see Field 06A.
W70-04473

THE EFFECT OF IMPOUNDMENTS ON NATURAL WATERS (IN GERMAN),
Akademiya Nauk SSSR, Leningrad (USSR).
W. I. Shadin.
Verh. Internat. Verein, Limnol., Vol. IV, p 792-805, July 1961.

Descriptors: *Lakes, *Reservoirs, Zooplankton, Phytoplankton, Temperature, *Epilimnion, *Hypolimnion, Algae, Fungi, Bacteria, Fish, Limnology, Hydrologic aspects, Aquatic environment, Water properties, Biological properties, Ecology, Stratification.
Identifiers: Water quality properties.

The building of impoundment qualitatively changes the biological and ecological system of water. A survey of response of water quality to the building of reservoirs and review of water quality properties in lakes and reservoirs in different geologic and climatic conditions is presented in the paper. The water quality and biological system of water in impoundment is dependent on many factors, such as hydrologic regime, climatic and regional conditions, purpose of reservoir, etc. The temperature distribution influences the detention (throughflow) time and formation of density layers with different water quality parameters. The chemical regime is mainly dependent on sludge formation. The amount of bacteria in water has two maximums during a year. The formation of zooplankton and phytoplankton is further discussed. The paper was presented as a leading lecture at XIV-th International Limnological Conference in 1961. (Novotny-Vanderbilt)
W70-04475

PREDICTION OF THERMAL ENERGY DISTRIBUTION IN DEEP RESERVOIRS,
Water Resources Engineers, Inc., Walnut Creek, Calif.
G. T. Orlob, and L. G. Selna.
Proceedings of the Annual Sanitary and Water Resources Engineering Conference, Technical Report No. 6, in Sanitary and Water Resources Engineering, Vanderbilt University, 1967. p 64-77, 1967. 8 fig, 3 ref.

Descriptors: *Thermal stratification, *Mathematical models, *Reservoirs, *Temperature, Thermocline, Heat transfer, Energy transfer, Digital computers, Diffusion, Epilimnion, Hypolimnion, Impoundments, Thermal conductivity, Tennessee Valley Authority Project, California, Lakes.

A mathematical model for simulation of thermal energy distribution (temperature) in impoundments is presented. Assumptions are made and justified concerning the one-dimensional approach to structuring the model, the nature of the heat transfer (eddy diffusion) coefficient, and selected boundary conditions. An example, derivation of the transfer coefficient A (z,t) from actual field data is presented and interpreted to show the limiting nature of the thermocline in energy transfer in the vertical and the nature of mixing in the epilimnion and hypolimnion. Results of a hypothetical test case for a reservoir receiving a natural runoff, including snow melt, are given and qualitatively compared to observed behavior of actual reservoirs. (Novotny-Vanderbilt)
W70-04476

TEMPERATURE CONTROL OF RESERVOIR RELEASES INTO NOLIN AND BARREN TAILWATERS,
Department of Fish and Wildlife Resources, Ky.
J. P. Carter.
Project, Department of Fish and Wildlife Resources, Kentucky, 1968. 36 p, 14 tab., 3 fig., 8 ref.

Descriptors: *Temperature, *Reservoirs, *Fishing, Electro-fishing, Fish harvest, *Temperature control, Thermal stratification, Thermal properties, Reservoir operation, Fish management, Limnology, Kentucky.
Identifiers: Kentucky reservoirs.

Investigations were conducted on Nolin Reservoir tailwater and Barren Reservoir tailwater to evaluate success in controlling tailwater temperatures through the utilization of multi-level releases, and to determine the fish population composition, and to measure fishing intensity, creel composition and fishing success on the tailwater. Gate-level releases were required during the temperature control period to control reservoir water levels and this contributed to lower tailwater temperatures during the months of April, May, June, and July. Electrofishing studies revealed that substantial numbers of

fishes emigrated from the reservoir into the tailwaters. Species dominance in the sections immediately below the dams fluctuated with the reservoir regulation period. During the seasonal pool period in the summer, game fishes and panfishes were most abundant; after drawdown in the fall threadfin shad was the dominant species; and prior to the seasonal pool period in early spring carp was the dominant species. The catch rate fluctuated from a low of 0.33 fish per hour at Barren to a high of 1.47 fish per hour at Nolin. The estimated annual harvest ranged from 3,486 fishes at Nolin to 15,852 fishes at Barren. At Nolin the creel was numerically dominated by crappies the third year of impoundment and sunfishes the fourth year. At Barren the creel was numerically dominated by suckers, carp, and crappies, respectively, during the first three years of impoundment. (Novotny-Vanderbilt)
W70-04478

NATURAL PROCESSES AND THEIR INFLUENCE ON RESERVOIR WATER QUALITY,
Wisconsin Univ., Madison. Dept. of Civil Engineering.
S. G. Walesh.
Journal American Water Works Association, Vol. 59, No. 1, p. 63-79, January 1967. 1 fig., 2 tab., 22 ref.

Descriptors: *Reservoir, *Thermal stratification, Water quality, Temperature, Dissolved oxygen, *Iron, *Manganese, Hypolimnion, Silica, Diatoms, Alkalinity, Oxygen, Water chemistry, Water quality control.
Identifiers: Lock Raven Reservoir, Gunpowder Falls River, Prettyboy Reservoir, Specific conductance.

A study was made to provide a representative description of the physical, chemical, and biological aspects of Loch Raven Reservoir, and to illustrate how natural phenomena may affect the quality of water in and from water supply impoundments. Results and discussions are presented on temperature, dissolved oxygen, silica, diatoms, iron, manganese, specific conductance, and alkalinity in the reservoir. The conclusions are that the effects of thermal stratification, hypolimnetic dissolved oxygen depletion, etc., are the result of processes in the sediment. The two most significant substances with nuisance potential which went into solution when hypolimnetic oxygen depletion occurred were iron and manganese. Draft gate operation can be a critical factor in determining the quality of water received from the reservoir. (Rietveld-Vanderbilt)
W70-04479

MATHEMATICAL SIMULATION OF THERMAL STRATIFICATION IN DEEP IMPOUNDMENTS,
Water Resources Engineers, Inc., Walnut Creek, Calif.
G. T. Orlob, and L. G. Selna.
Proceedings, ASCE Specialty Conf. on Current Research into the Effects of Reservoirs on Water Quality, Jan. 1968, Technical Report No. 17 in Environmental and Water Resources Engineering, Vanderbilt University, Nashville, Tenn, 33 p. 10 fig., 20 ref.

Descriptors: *Mathematical models, *Temperature, *Impoundments, Lakes, Reservoirs, Epilimnion, Hypolimnion, Thermocline, *Thermal stratification, Diffusion, Mixing, Heat balance, Energy transfer, Digital computers, Heat transfer, Temperature gradient, Thermal properties, Thermal conductivity, Inflow.

A theory and practical experience with mathematical modeling of the thermal behavior of water in reservoirs and lakes is presented in the paper. As to diffusion processes occurring in heat mixing, it was stated that (1) Effective mixing in the epilimnion is greatest near the surface but declines rapidly with depth as the thermocline is approached. (2) The effective diffusion coefficient is minimal at or very near the position of the thermocline. (3) In the hypolimnion the effective diffusion coefficient increases with depth in a erratic manner, reaching a maximum roughly equivalent to that of the epilimnion at about mid-depth, thereafter decreasing as the bottom is approached. Model was verified using the real data and conclusions are the following: (1) The transfer of energy into deep stratified impoundments is accomplished by advection, direct solar insolation, convective mixing associated with cooling at the surface, and effective diffusion. (2) The transfer of energy from the epilimnion to the hypolimnion by diffusion is limited at the thermocline. (3) A one-dimensional mathematical representation of energy transfer processes is satisfactory for deep reservoirs. (4) Reservoir thermal behavior over annual or diurnal cycles can be simulated with a mathematical model using as input information continuous records of hydrologic, meteorologic, and climatologic conditions of the system. (Novotny-Vanderbilt)
W70-04481

DEVELOPMENT OF A MATHEMATICAL MODEL FOR PREDICTION OF TEMPERATURE IN DEEP RESERVOIRS PHASE I: LOW DISCHARGE VOLUME RATIO RESERVOIRS,
Water Resources Engineers, Inc., Lafayette, Calif.
For primary bibliographic entry see Field 06A.
W70-04483

IMPOUNDMENT DESTRATIFICATION FOR RAW WATER QUALITY CONTROL USING EITHER MECHANICAL OR DIFFUSED AIR PUMPING,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
For primary bibliographic entry see Field 05F.
W70-04484

FIELD EXPERIMENTS ON THE EFFECT OF LIGHT CONDITIONS IN PHRAGMITES STANDS ON THE PRODUCTION OF LITTORAL ALGAE,
Warsaw Univ. (Poland). Dept. of Hydrobiology; and Ceskoslovenska Akademie Ved, Prague. Hydrobiological Station.
E. Pieczynska, and M. Straskraba.
Bulletin de l'Academie Polonaise des Sciences (Serie des Sciences Biologiques), Vol 17, No 1, p 43-46, 1969. 2 fig, 4 ref.

Descriptors: *Radiation, *Analytical techniques, *Photosynthesis, *Algae, Plankton, Biomass, Littoral, Periphyton, Light intensity, Chlorophyll, Oxygen, Phosphorus, Nitrogen.
Identifiers: *Phragmites, Cladophora, Spirogyra, Smyslov Pond (Czechoslovakia), Southern Bohemia, Macrophytes.

Photosynthesis of planktonic and periphytic algae was determined in parts of Smyslov Pond, southern Bohemia, occupied by reeds, and in adjacent area free from macrophytes. Light and dark oxygen bottles with freshly collected Cladophora and Spirogyra spp, volumeter, Kjeldahl and Winkler methods served as analytical tools. Intensity of light and daily radiation were recorded by a photocell and a solarimeter. The chlorophyll content was also determined at four wavelengths by a spectrophotometer. The production of algae was considerably higher in open water than in portions of the pond shaded by reeds. The relationship under conditions of observation and on a per day basis was expressed by the equation: milligram oxygen/milligram nitrogen = 0.949 log gram calorie/square centimeter - 1.208. (Wilde-Wisconsin)
W70-04491

TREATMENT OF ALGAE AND WEEDS IN LAKES AT MADISON,
Health Dept., Madison, Wis. Lab.
Bernard P. Domogalla.
Engineering News-Record, Vol 97, No 24, p 950-954, 1926. 8 fig, 3 tab.

Descriptors: *Copper sulfate, *Eutrophication, *Algae, *Aquatic weeds, Lakes, Algicides, Aquatic weed control, Mechanical control, Water pollution control, Chemcontrol, Arsenic compounds, Nitrogen, Phosphorus.
Identifiers: *Madison lakes (Wis), *Aquatic weed cutting, *Weed extracting steel cables, Algal succession, Anabaena, Cladophora, Pediastrum, Hydrodictyon, Potamogeton, Ranunculus.

Field and laboratory investigations of highly eutrophic lakes in the vicinity of Madison yielded several conclusions. The copper sulfate dragging method proved to be most effective for suppression of bottom-anchored algae on wind exposed areas. The surface algae and those inhabiting shallow waters were best controlled by spraying with copper sulfate. Weeds in open water were eliminated by weed-cutting machines. Stems and roots of weeds in shallow waters and near shore lines were extracted by steel cables with clips and swivels. Several species of water weeds were eradicated by sodium arsenite. The study disclosed a seasonal succession of aquatic plants and a pronounced relationship between eradication treatments and biological fixation of available forms of nitrogen and phosphorus. (Wilde-Wisconsin)
W70-04494

THE BOTTOM FAUNA OF LAKE VATTERN, CENTRAL SWEDEN, AND SOME EFFECTS OF EUTROPHICATION,
Ulf Grimas.
Institute Freshwater Research Reports, Drottningholm, Sweden, Vol 49, p 49-62, 1969. 3 fig, 3 tab, 18 ref.

Descriptors: *Lakes, *Benthic fauna, *Eutrophication, *Biomass, Productivity, Phosphorus, Nitrogen, Organic matter, Water pollution effects.
Identifiers: *Lake Vattern (Sweden), Sweden, Oligotrophic lakes, Pontoporeia affinis.

Lake Vattern, a large oligotrophic lake, is being subjected to inputs of phosphorus and nitrogen (resulting from human activities) at rates of 200 and 400 metric tons/year, respectively. Phosphorus input has increased approximately 300% during the last 50 years. Input of nitrogen from all sources, including precipitation, is about 1900 metric tons/year; organic matter, excluding industry and communities, is estimated at 50,000 metric tons/year. Biomass of benthic organisms ranges from 0.6 to 9.6 grams/square meter, dependent on depth and section of lake. Greatest numbers and biomass are found in depth ranges 0-20 meters (littoral) and 40-60 meters. Large crustaceans and oligochaetes dominate profundal (40-100 meter-depth) region; chironomids (Orthocladiinae, Tanytarsini, Chironomini) dominate littoral region. Highest average biomass (4-6 grams/square meter) is found in littoral region at southern end of the lake, where phosphorus and organic-matter input is greatest. Comparisons with data of 1911-1914 show increases in filtering animals (sphaeriids) and large crustaceans; these are considered indicative of an early phase of eutrophication. (Voigtlander-Wisconsin)
W70-04495

THE ECOLOGICAL DECLINE OF LAKE ERIE,
New York State Coll. of Agriculture, Ithaca.
Dean F. Arnold.
New York Fish and Game Journal, Vol 16, No 1, p 27-45, 1969. 5 fig, 69 ref.

Descriptors: *Lake Erie, *Eutrophication, *Water pollution effects, *Water pollution sources, Domestic wastes, Dissolved oxygen, Zooplankton, Benthic fauna, Fisheries, Walleye.
Identifiers: *Cultural eutrophication, Maumee River (Mich), Detroit River (Mich), Blue pike, Coregonids, Sturgeon.

Lake Erie is perhaps the best-documented example of a large lake which is deteriorating rapidly in several aspects, including eutrophy. The shallow Western Basin is exposed to high sediment loads, contributed largely by farmland erosion transported by the Maumee River. Human activities, including construction of jetties and erosion-control structures have increased total shore erosion and silt load. Effects of domestic and industrial pollution are most noticeable in the Western Basin. All chemical constituents except silicate and iron have increased from about 16 to 300% since 1906. Oxygen depletion is most notable in the deeper Central Basin. Average quantity of phytoplankton has increased threefold; shifts in species composition have been noted. Blue-green algae have become a dominant form; attached and floating algae have increased. Cladoceran zooplankton have increased as have characteristically eutrophic species of copepods. Mayfly naiads (Hexagenia) have decreased markedly while Oligochaetes, chironomid larvae and sewage fungus have increased. Populations of coregonids, sturgeon, pike (Stizostedion) have collapsed; shad, alewife, smelt, and carp have increased. Several feasible remedial actions have been proposed; their practicability and efficacy is difficult to predict. (Voigtlander-Wisconsin)
W70-04496

DISTRIBUTION OF C-14 IN PRODUCTS OF PHOTOSYNTHESIS AND ITS RELATIONSHIP TO PHYTOPLANKTON COMPOSITION AND RATE OF PHOTOSYNTHESIS,
Ashland Coll., Ohio. Dept. of Biological Sciences.
John H. Olive, Duane M. Benton, and Jack Kishler.
Ecology, Vol 50, No 3, p 380-386, 1969. 6 fig, 2 tab, 31 ref.

Descriptors: *Lakes, *Photosynthesis, *Phytoplankton, Methodology, Standing crop, Proteins, Carbohydrates, Lipids, Growth rates, Lake Erie.
Identifiers: *Carbon-14, *Photosynthetic rate, Cascinodiscus, Aphanizamenon, Microcystis, Ceratium.

Distribution of carbon-14 in four dominant species of phytoplankton was determined from in situ cultures. Ethanol-soluble fractions of phytoplankton accounted for 25-60% of assimilated carbon-14; insoluble fractions accounted for 20-48%. Ion-exchange fractionation of ethanol-soluble fraction revealed 68-83% of carbon-14 in carbohydrate-lipid fraction; 8-23% in non-amino organic acid fraction and 3-20% in free amino acid fraction. Distribution of carbon-14 in different fractions varied with species of alga, rate of population increase and level of illumination. Rapidly-growing populations showed higher proportions of carbon-14 in protein fractions; high proportions of carbon-14 in carbohydrate-lipid fractions were associated with high photosynthetic rates. Graphical data include temporal variation in distribution of carbon-14 and in total and relative rates of photosynthesis. (Voigtlander-Wisconsin)
W70-04497

THE LIMNOLOGY AND PRODUCTIVITY OF THREE CALIFORNIA COLDWATER RESERVOIRS,
California State Dept. of Fish and Game, Sacramento. Inland Fisheries Branch.
Stephen J. Nicola, and David P. Borgeson.
California Fish and Game, Vol 56, No 1, p 4-20, 1970. 8 fig, 3 tab, 20 ref.

Descriptors: *Limnology, *Productivity, *Fish, *Reservoirs, Zooplankton, Rainbow trout, Primary productivity, Secondary productivity, Daphnia, Copepods, Dissolved oxygen, Brown trout, Trophic level, California, Food habits, Food chains.
Identifiers: *Sierra Nevada reservoirs, Lake Spaulding (Calif), Beardsley Reservoir (Calif), Icehouse Reservoir (Calif), Bosmina, Holopedium, Kokanee.

Three reservoirs on the western slope of the Sierra Nevadas yielded estimates of mean daily net primary productivity from 119 to 314 milligrams carbon/square meter (June through October). Mean standing crops of zooplankton ranged from 562 to 951 milligrams/square meter dry weight; mean annual yield of game fish ranged from 0.75 to 6.71 kilograms/hectare wet weight. Primary productivity appeared to be directly related to temperature and inversely related to flushing rate of the reservoirs. Rotifers were most numerous zooplankter but did not contribute significantly to total weight. Dominant zooplankton for Beardsley, Icehouse, and Spaulding Reservoirs were, respectively, (1) Daphnia and calanoid copepods, (2) cyclopoid copepods, and (3) Bosmina coregoni. Fisheries consisted of rainbow and brown trout in all three lakes and included kokanee in Icehouse. Game fish yield in Spaulding and Beardsley varied from 0.69 to 0.87 and 2.99 and 9.84 kilogram/hectare, respectively. Kokanee assumed a dominant role in the Icehouse fishery two years after introduction. Zooplankton dominated fish diets in Beardsley, aquatic invertebrates and terrestrial organisms dominated diets in Spaulding. Comparison of productivity indices suggest all three fisheries are under-utilized. (Voigtlander-Wisconsin)
W70-04498

BIOLOGY OF THE CRAYFISH ORCONECTES CAUSEYI AND ITS USE FOR CONTROL OF AQUATIC WEEDS IN TROUT LAKES,
Bureau of Sport Fisheries and Wildlife, Washington, D.C.
Jack L. Dean.
Bureau of Sport Fisheries and Wildlife, Technical Paper, No 24, 1969. 15 p. 8 fig, 3 tab, 14 ref.

Descriptors: *Crayfish, *Aquatic weeds, *Aquatic weed control, Ecology, Life history studies, Fecundity, Fish management.
Identifiers: *Trout lakes, Potamogeton, Myriophyllum, Ranunculus, Chara, Ceratophyllum, Elodea.

Control of submerged aquatic plants has been achieved in shallow lakes of the Southwest by introduction of the crayfish Orconectes causeyi. Crayfish growth is rapid during summer (June through late September). Both sexes attain maturity at 14 to 15 months; maximum ages of both sexes is about 37 months. Females produce high numbers of ovarian eggs (mean of 62 females was 588, maximum number was 1237); reduction to number of pleopod eggs was estimated to be 29%. O causeyi is a tertiary burrower, utilizing a variety of substrate types. It is primarily vegetarian (diet consisted of 51% algae, 27% vascular plant material, 18% detritus, and 4% animal food); cannibalism will occur under conditions of food scarcity. Weed control was proportional to crayfish population and proximity to a rocky substrate. Field and laboratory tests showed control or utilization of Potamogeton spp, Ceratophyllum, Ranunculus, Elodea, Myriophyllum, Chara, Najas, Cabomba, and Vallisneria. Crayfish did not control Polygonum, Scirpus, or Typha. Control includes habit of cutting vegetation at the substrate and uprooting vegetation. Comparison of life history data with those of O virilis suggests that the latter species may be an effective weed-control agent in the upper Midwest. (Voigtlander-Wisconsin)
W70-04500

2I. Water in Plants

AN EXPERIMENTAL STUDY OF THE UPTAKE OF WATER BY SOYBEAN ROOTS,
Illinois Univ., Urbana. Dept. of Agronomy.
For primary bibliographic entry see Field 02D.
W70-04069

SAGEBRUSH CONVERSION TO GRASSLAND AS AFFECTED BY PRECIPITATION, SOIL, AND CULTURAL PRACTICES,
Geological Survey, Denver, Colo. Water Resources Div.
For primary bibliographic entry see Field 03B.
W70-04322

EFFECTS OF IRRIGATION REGIMES ON GRAPEFRUIT PEEL AND PULP RELATIONSHIPS,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
A. Cohen, A. Goell, A. Rassis, and M. Gokkes.
Israel Journal of Agricultural Research, Vol 18, No 4, p 155-160, October 1968. 4 tab, 7 ref.

Descriptors: *Grapefruit, *Irrigation effects, *Crop response, *Irrigation practices, *Rates of application, Citrus fruits.
Identifiers: *Israel, *Peel/pulp ratio.

A higher peel/pulp ratio occured in grapefruit from trees receiving limited irrigation than was found in trees that were frequently and amply irrigated. Irrigation effects were most strongly marked during the rainless summer period, when the drier regimes inhibited peel growth relatively more than pulp growth. However, even though the peel grew less than the pulp, it concerned a smaller fraction of total growth and the final figures showed that the drier regimes yielded fruit with a higher peel/pulp ratio. (Carr-Arizona)
W70-04403

ROW SPACING AND FERTILIZATION INFLUENCES ON FORAGE AND SEED YIELDS OF INTERMEDIATE WHEATGRASS, RUSSIAN WILDRYE, AND GREEN NEEDLEGRASS ON DRYLAND,
Agricultural Research Service, Sidney, Mont. Northern Plains Soil and Water Research Center; and Montana Agricultural Experiment Station, Bozeman.
A. L. Black, and L. L. Reitz.
Agronomy Journal, Vol 61, No 5, p 801-805, September-October 1969. 2 fig, 3 tab, 14 ref.

Descriptors: *Great Plains, *Fertilization, *Forage grasses, *Seeds, *Crop response, Phosphorous, Nitrogen compounds, Water utilization, Crop production, Semiarid climates.
Identifiers: *Row spacing, Seed yield.

The purpose of this five-year study was to determine the effects of row spacing and fertilization on forage and seed production of intermediate wheatgrass, Russian wildrye, and green needlegrass. These three grasses are commonly grown on the dry northern Great Plains and intensive soil management was practiced in order to study their maximum water-use efficiencies. The grasses differed in their response (forage, seed production, water use, and nitrogen and phosphorous recovery) to spacing and fertilizing combinations. Green needlegrass was particularly noticeable for its low water-use efficiency in comparison to the other grasses. It is concluded that the optimum row spacing is 107, 76, and 76 cm respectively for intermediate wheatgrass, Russian wildrye, and green needlegrass. 40 to 60 kg/ha of nitrogen with phosphorous added should be applied annually. (Carr-Arizona)
W70-04406

MOISTURE CONTENT OF COTTON LEAVES AND PETIOLES AS RELATED TO ENVIRONMENTAL MOISTURE STRESS,
Texas A and M Univ., College Station; and Texas Agricultural Experiment Station, El Paso.
D. E. Longenecker, and P. J. Lyerly.
Agronomy Journal, Vol 61, No 5, p 687-690, September-October, 1969. 3 fig, 16 ref.

Descriptors: *Moisture stress, *Soil moisture, *Cotton, *Leaves, *Soil-water-plant relationships, Irrigation, Timing, Irrigation efficiency, Moisture deficit, Arid lands, Soil types, Plant physiology, Wilting point.
Identifiers: *Petioles.

The purpose of the study was to determine the change over a period of time of leaf and petiole moisture content in cotton. The study interval began following irrigation and continued until permanent wilting developed. In both field and greenhouse conditions, there was a gradual decrease in leaf and petiole moisture percentage as soil moisture was depleted. Throughout this period the petioles showed the more uniform depletion curves and higher moisture percentages. This would indicate that petioles are more useful and dependable in registering changes in soil-water-plant relationships. Before this information could be used to predict when to irrigate, it appears it would be necessary to calibrate data for different soil types. (Carr-Arizona)
W70-04407

AN ECOLOGICAL SIGNIFICANCE OF SEASONAL LEAF VARIABILITY IN A DESERT SHRUB,
California Univ., Riverside. Dept. of Life Sciences.
G. L. Cunningham, and B. R. Strain.
Ecology, Vol 50, No 3, p 400-408, Late Spring 1969. 7 fig, 3 tab, 18 ref.

Descriptors: *Desert plants, *Variability, *Plant morphology, *Leaves, *Photosynthesis, Arid lands, Structure, Carbon dioxide, Resistance, Water vapor, Diffusion, Biorythms, Soil water, Seasonal, Precipitation (Atmospheric), On-site tests.
Identifiers: *Brittlebush, *Sonoran Desert, *Moisture status, Leaf structure.

The study was designed to find out to what extent seasonal leaf variability increases the survival capability of Encelia farinosa. This particular plant species was selected for observation because it is a perennial showing great seasonal variation in leaf structure and quantity. Field records established that leaf quantity and structure are controlled by environmental moisture status. Field observations also demonstrated the influence of leaf quantity and structure on CO sub 2 exchange capacity and water status of the shrub. These findings were corroborated by laboratory investigations, which also indicated that influence of leaf structure is due to alteration in the resistances to CO sub 2 and water vapor diffusion. The conclusion is that seasonal leaf variability provides Encelia farinosa with an increased ability to accumulate photosynthate in a desert environment. (Carr-Arizona)
W70-04414

EFFECTS OF WATER POTENTIAL ON GERMINATION OF LETTUCE, SUNFLOWER, AND CITRUS SEEDS,
California Univ., Riverside, Dept. of Horticultural Science.
Merrill R. Kaufmann.
Canadian Journal of Botany, Vol 47, No 11, p 1761-1764, November 1969. 3 fig, 1 tab, 6 ref.

Descriptors: *Moisture stress, *Seeds, *Germination, *Lettuce, *Citrus fruits, Arid lands, Semiarid climates, Solutes, Moisture availability.
Identifiers: *Water potential, *Sunflowers.

In arid and semiarid climates there may be a critical shortage of water at the time of seed germination. The study deals with the effect of controlled water potential or germination of citrus, sunflower, and lettuce seeds. The method for achieving nearly constant water potential without solute effect is based on the principles of Painter, Cox, and Boersma. For all three species tested the most rapid emergence occurred at 0 bars. Sunflowers germinated at water potentials as low as -8.0 bars, citrus at -4.7 bars, and lettuce at-4.1 bars. Citrus germinated most slowly, requiring 26 days at 0 bars to achieve 50% germination. Sunflowers reached 50% germination in 8 days at-4.1 bars, but lettuce required -2.3 bars before it could germinate at the same rate. (Carr - Arizona)
W70-04416

AN UNUSUAL PHOTONASTISM INDUCED BY DROUGHT IN PHASEOLUS VULGARIS,
Department of Agriculture, Lethbridge (Alberta). Research Station.
S. Dubetz.
Canadian Journal of Botany, Vol 47, No 10, p 1640-1641, October 1969. 2 fig, 9 ref.

Descriptors: *Beans, *Drought, *Moisture stress, *Crop response, *Plant physiology, *Phototropism, Water utilization, Turgidity, Thermal stress, Transpiration, Soil-water-plant relationships, Leaves, Solar radiation, Thermal capacity.
Identifiers: *Photonastism, Canada.

In an outdoor experiment Phaseolus vulgaris was subjected to moisture stress. 30 to 40 days after emergence some of the plants were placed under soil water stress of 8 bars. On hot, sunny days the stressed plants exhibited the photonastic phenomenon. Photonasty is considered a special case of phototropism in which the light response of mature plant tissue consists of turgor changes. Under conditions of extreme drought and intense sunlight the leaves of P. vulgaris orient themselves parallel to the incident light. In this position they will follow the course of the sun. This leaf orientation and movement apparently are adaptations to minimize transpiration and prevent thermal death. (Carr - Arizona)
W70-04417

EFFECT OF MOISTURE STRESS ON THE ABSORPTION AND TRANSPORT OF HERBICIDES IN WOODY PLANTS,
Agricultural Research Service. Crops Research Division; and Texas A and M Univ. Dept. of Range Science.
F. S. Davis, M. G. Merkle, and R. W. Bovey.
Botanical Gazette, Vol 129, No 3, p 183-189, September 1968. 5 fig, 4 tab, 14 ref.

Descriptors: *Herbicides, *2-4-5-T, *Absorbtion, *Moisture stress, *Mesquite, Chaparral, Brush control, Range management, Defoliants, Plant physiology, Arid lands, Semiarid climates, leaves, Analytical techniques, Vascular tissues, Turgidity.
Identifiers: *Picloram, *Winged elm.

Mesquite and winged elm were studied in a controlled environment to determine the effect of moisture stress on the absorption and distribution of 2,4,5-T and picloram. Moisture stress did not effect absorption of 2,4,5-T, but did reduce uptake of picloram in mesquite. Stress also reduced transport of the herbicides in both species, with reduction generally paralleling retarded growth. The greatest reduction in transport occurred either at moderate stresses or when extensive movement occurred under no stress. (Carr - Arizona)
W70-04418

2J. Erosion and Sedimentation

SOIL MOVEMENT IN AN ALPINE AREA,
Colorado State Univ., Fort Collins. Natural Resources Center.
W. D. Striffler.
Available from the Clearinghouse as PB-189 785, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 4 p, 3 ref. OWRR Project A-002-COLO.

Descriptors: *Soil erosion, *Alpine soil, *Tundra erosion, Sediment transport, Soil movement.

Erosion transects were established at two alpine sites in Colorado. Site variables included two aspects (north and south), two slope positions (upper and lower), and three slope classes ranging from five to sixty percent. Soil particle tagging with flourescent dye permitted soil migration to be observed. Small micro-plots were fitted with soil collectors to catch migrating soil particles for laboratory analysis. Maximum soil particle displacement on undisturbed steep mountain slopes averaged less than one meter over a two-year period. Particle movement is highly correlated with no deposition. Particle movement is also correlated with slope, position on slope, litter cover, rock cover, and infiltration rate. Surface soil particle, sprayed with flourescein dye remain sufficiently visible for observation over a two-year period.
W70-04059

HYDRAULIC RESISTANCE IN ALLUVIAL CHANNELS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ben Chie Yen, and Ying-Chang Liou.
Available from the Clearinghouse as PB-189 789, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Illinois Water Resources Center, Research Report No 22, July 1969. 66 p, 24 tab, 5 fig, 51 ref, 1 append. OWRR Project A-033-ILL.

Descriptors: *Alluvial channels, Dimensional analysis, *Flow resistance, Hydraulics, Open-channel flow.
Identifiers: *Sediment.

An analytical study was conducted for the determination of the Weisbach resistance coefficient for flow in sand-bed straight channels. Available experimental data were reanalyzed based on dimensional analysis and fluid mechanics concepts. It was found that for flows having width to depth ratio greater than 5, there is a unique and systematic relationship among the Weisbach resistance coefficient f, and Frounde number of the flow, and the sediment particle size to hydraulic radius ratio. The bed form which also is a dependent variable is also uniquely determined. For flow with Frounde number less than 0.5 where its effect can be neglected, the resistance coefficient can be expressed as a function of the Reynolds number, sediment size to hydraulic radius ratio, and the sediment terminal fall velocity to shear velocity ratio. Application of the results for engineering purposes is also discussed. The technique for engineering applications of the results appear to be quite simple.
W70-04070

COMPOSITION OF INTERSTITIAL WATERS OF MARINE SEDIMENTS: TEMPERATURE OF SQUEEZING EFFECT,
Southern California Univ., Los Angeles.
For primary bibliographic entry see Field 02K.
W70-04075

FUNCTIONAL RELATIONSHIPS BETWEEN DENUDATION, RELIEF, AND UPLIFT IN LARGE MID-LATITUDE DRAINAGE BASINS,
Maryland Univ., College Park. Dept. of Geography.
Frank Ahnert.
American Journal of Science, Vol 268, No 3, p 243-263, Mar 1970. 21 p, 7 fig, 2 tab, 21 ref.

Descriptors: *Erosion, *Topography, *Geomorphology, Geology, Precipitation (Atmospheric), Drainage density, Drainage patterns (Geologic), Land forming, Structural geology.
Identifiers: Geological uplift.

The mean denudation rate in mid-latitude river basins is directly proportional to mean basin relief. Mean annual precipitation has no noticeable effect upon the denudation rate. Without any uplift, the relief is reduced to 10% of its initial value in 11 million years; with isostatic compensation, this time increases to at least 18.5 million years. Establishment of a steady state relief would require a constant rate of uplift for more than 20 million years and thus is unlikely to occur. Oscillating rates of uplift cause corresponding oscillations of relief. The quantitative relationship between uplift, relief, and denudation may permit order-of-magnitude estimates of current rates of uplift. (Knapp-USGS)
W70-04076

THE NATURE OF KARSTIC PROCESSES IN THE PERMIAN HALOGEN SEDIMENTS OF THE DONETS BASIN USING THE BAKHMUT BASIN AS AN EXAMPLE (RUSSIAN),
N. S. Podorvanov, and Ye. A. Savichenko.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostnykh i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 80-83, 1969. 4 p.

Descriptors: *Karst, *Erosion, *Sediments, Geology, Clays, Limestones, Sands, Gypsum, Salts, Groundwater, Boreholes, Mining, Leaching, Groundwater movement.
Identifiers: Donets basin, USSR.

The geology of the Permian rocks in the Bakhmut basin and the development of the basin's karstic features are described. The karstic processes of the basin take place in the halogen-carrying formations of Lower Permian age located at relatively shallow depth. Leaching of these halogen formations is due to the circulation surface and underground waters and takes place down to depths of 40 to 250 m. (Gabriel-USGS)
W70-04105

KARST AND ASSOCIATED UNDERGROUND WATERS OF THE SOUTHWESTERN PART OF THE DONETS BASIN (RUSSIAN),
Akademiya Nauk URSR, Kiev. Instytut Geologichnykh Nauk.
For primary bibliographic entry see Field 02F.
W70-04106

KARST FORMATION AT THE ARTEMOVSK OCCURRENCE OF ROCK SALT (RUSSIAN),
I. M. Aleksandrov.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostnyky i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 73-79, 1969. 7 p, 1 fig, 1 tab.

Descriptors: *Karst, *Aquifers, *Groundwater, *Mineral industry, *Salts, Discharge (Water), Mine drainage, Mine water, Mining engineering, Water chemistry, Sulfates, Deterioration, Geology, Sandstones, Runoff, Surface runoff, Water circulation, Boreholes, Corrosion.
Identifiers: *USSR, Artemovsk mines.

The formation of karstic features in the rock salt horizon of the Artemovsk rock-salt mine is described. The discharge values of water in shafts and tunnels of the mine, the geology of water-bearing horizons and streams, and the damage done to the concrete used in the mine are also discussed. (Gabriel-USGS)
W70-04107

A DEVICE FOR DETERMINING SEDIMENTATION RATES IN RESERVOIRS,
Bureau of Sport Fisheries and Wildlife, Yankton, S. Dak. North Central Reservoir Investigations.
Bruce C. Cowell, and Patrick L. Hudson.
Limnology and Oceanography, Vol 13, No 1, p 196-198, 1968. 2 fig.

Descriptors: *Sedimentation rates, *Reservoirs, Deposition (Sediments), Cores, Sampling, Currents (Water), Velocity, SCUBA diving.
Identifiers: *Sediment trap, Gross sedimentation rates, Sediment composition.

A more rapid determination of sedimentation rates and sediment composition in reservoirs than core sampling and not subject to errors associated with open containers can be effected with the apparatus described. It can be stabilized at desired depths so that flocculent bottom materials are not collected, and it can be closed before retrieval. The data obtained with this device are more closely representative of the gross sedimentation rate than the net rate that actually prevails, and thus determinations of energy flux tend to be artificially high. For this reason, the apparatus is used only to provide comparative data between stations within a reservoir or between reservoirs in the same river system. In operation, this sediment trap, is slowly lowered to the bottom with an anchor and messenger cable. Bottom materials are disturbed by the anchor as little as possible. After 24-48 hours a messenger is dropped and the sediment trap retrieved. The operation was observed with SCUBA equipment and current was found the major factor limiting use. The device could be modified for use in currents so that it would remain vertical, regardless of apparatus tilt. (Jones-Wisconsin)
W70-04191

NEW METHODS OF PROBABILITY CALCULATIONS FOR DISCHARGES AND NON-SCOURING VELOCITIES IN RIVERS' CROSS-SECTIONS,
Institute of Building Technics, Warsaw (Poland).
Walenty Jarocki.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 73, p 589-594, 1967. 6 p, 3 tab, 2 ref.

Descriptors: *Erosion, *Scour, *Probability, *Statistical methods, *Streamflow forecasting, Discharge (Water), Stage-discharge relations, Channel morphology.
Identifiers: Scour prediction.

New methods of calculation of probabilities of discharges as well as sediment balance for the calculation of scour near hydraulic structures are presented. The methods are based on the assumption that the discharges of various probability should be calculated taking into account the maximum discharge which can occur in the given basin. According to the principle of conservation of energy the river bed will not scour if the quantity of sediment is the same downstream and upstream of the considered contract river cross-section. (Knapp-USGS)
W70-04255

ROLE OF SALT WEDGE IN BAR-FINGER SAND AND DELTA DEVELOPMENT,
Northeastern Illinois State Coll., Chicago. Dept. of Geology.
George T. Moore.
The American Association of Petroleum Geologists Bulletin, Vol 54, No 2, p 326-333, Feb 1970. 8 p, 6 fig, 4 tab, 10 ref.

Descriptors: *Deposition (Sediments), *Sediment transport, *Saline water intrusion, *Mississippi River, *Deltas, Sedimentation, Sedimentary structures, Sand bars, Coasts.
Identifiers: Bar-finger sands.

Linear, continuous deposits, composed primarily of fine and very fine sand, which occupy the channels and distributaries of the lower Mississippi River are termed 'bar-finger sands.' These deposits originate as distributary-mouth bars but their development continues after the river has prograded beyond the original site of bar formation. The intrusion of salt water into the river channel during periods of low discharge reduces the current directly above the bed and causes deposition of the coarser fractions of sand along the channel. Because this phenomenon occurs during much of the year, a net buildup of sediment occurs. (Knapp-USGS)
W70-04306

EFFECT OF CONCENTRATION ON SEDIMENT DISTRIBUTION,
Missouri Univ., Columbia. Dept. of Civil Engineering.
A. T. Hjelmfelt, and C. W. Lenau.
ASCE Proceedings, Journal Hydraulics Division, Vol 95, No HY5, p 1775-1779, Sept 1969. 5 p, 2 fig, 3 ref. OWRR Project No A-015-MO.

Descriptors: *Sedimentation, *Suspended load, *Settling velocity, Deposition (Sediments), Mathematical studies, Particle size, Sediment load, Stokes law, Suspension.
Identifiers: Sediment concentration.

The effects of sediment concentration on the fall velocity of suspended material are studied analytically. The results are shown by graphs. (Knapp-USGS)
W70-04320

THE RELATION OF TURBULENCE TO DEPOSITION OF MAGNETITE OVER RIPPLES,
Geological Survey, Fort Collins, Colo.
Raul S. McQuivey, and Thomas N. Keefer.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75. Geological Survey Research 1969, Professional Paper 650-D, p D244-D247, 1969. 4 p, 3 fig, 2 ref.

Descriptors: *Deposition (Sediments), *Sediment transport, *Turbulence, *Ripple marks, *Hydraulic models, Settling velocity, Density, Separation techniques, Sedimentary structures, Turbulent flow, Erosion, Scour.
Identifiers: Heavy minerals, Magnetite, Sorting.

Sorting of magnetite and other heavy minerals from predominantly quartz bed material occurs because of variations in turbulent shear stress from trough to crest of ripples and because for particles less than one-tenth millimeter in diameter critical shear stress is a function of density only. The sorted particles of heavy minerals tend to accumulate just upstream of ripple crests. It is suggested that artificially generated turbulence could be employed to sort small-sized heavy-mineral particles from sediment flows. (Knapp-USGS
W70-04343

THE DEVELOPMENTAL HISTORY OF BLELHAM TARN (ENGLAND) AS SHOWN BY ANIMAL MICROFOSSILS, WITH SPECIAL REFERENCE TO THE CLADOCERA,
Indiana Univ., Bloomington. Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W70-04459

AN ELECTRO-OPTICAL SYSTEM FOR MEASUREMENT OF MEAN AND STATISTICAL PROPERTIES OF SEDIMENT SUSPENSIONS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
John R. Glover, P. K. Bhattacharya, and John F. Kennedy.
U S Army Corps of Engineers, Coastal Engineering Research Center, Washington, D C, Technical Report IIHR No 120, October 1969. 26 p. 15 fig.

Descriptors: *Erosion, *Sediment distribution, Sedimentation, Sediment-water interfaces, Instrumentation, Measurement, Beach erosion, Alluvial channels, Estuaries, Waves (Water), Shoals, Computers, Suspension.
Identifiers: *Suspended sediment, *Erosion transport, *Electro-optical measurement, Shoaling waves, Optical transducer, Multi-phase flow.

To achieve measurements of the mean, periodic, and random components of the concentration of suspended products or erosion, a new electro-optical system has been developed. The system includes a transducer of a gallium arsenide diode and a silicon planer diode as a light sensor. The intensity of light is modulated by the suspended material in the gap between the light source and sensor. The chassis is provided with signal analyzing circuitry, an analog- to-frequency converter, and multiplier circuits. The device measures suspension to 100 parts/million, computes the mean concentration,

the mean square of the fluctuation, and the correlation between the concentration and another signal supplied by the system. (Wilde-Wisconsin)
W70-04492

2K. Chemical Processes

SOLUTION GEOCHEMISTRY OF THE WATER OF LIMESTONE TERRAINS,
Kentucky Water Resources Inst., Lexington.
John Thrailkill.
Available from the Clearinghouse as PB-189 773, $3.00 in paper copy, $0.65 in microfiche. Research Report 19, Kentucky Water Resources Institute, Lexington, 1970. 125 p, 10 tab, 22 fig, 26 ref. OWRR Project A-009-KY.

Descriptors: Aquifers, Limestone, Vadose seepage, *Geochemistry, Calcite, Water quality, Analytical techniques, Kentucky, Calcium carbonate, Carbon dioxide, Carbonates, Karat.
Identifiers: *Limestone aquifer, *Groundwater.

Limestone groundwater flows mainly in openings it has solutionally enlarged, thus an understanding of the water's state of saturation relative to calcite (the principal mineral component of limestone) is fundamental to an understanding of the nature and evolution of the limestone aquifer. This study investigated the Mammoth Cave-Sinkhole Plain (MCSP) and Cave Hollow (CH) aquifers in Kentucky. Both aquifers were always undersaturated with calcite. Except for completely ventilated vadose flows and some vadose seepage, all recharges sampled were also undersaturated. The lack of saturation in the MCSP aquifer was due to the introduction of carbon dioxide into the water in amounts difficult to explain by the above recharges. In both vadose flows and seepage, undersaturation tended to correlate directly with flow volume, and there was an inverse correlation between the amount of carbon dioxide and calcite saturation in most of the waters sampled, suggesting seasonal invariance of carbon dioxide content of the water prior to outgassing. Results suggest solutional enlargement is greatest near recharge points in 'ventilated' aquifers (CH) but the carbon dioxide introduction phenomenon (MCSP) allows solution over wide areas in 'unventilated' aquifers.
W70-04061

COMPOSITION OF INTERSTITIAL WATERS OF MARINE SEDIMENTS: TEMPERATURE OF SQUEEZING EFFECT,
Southern California Univ., Los Angeles.
James L. Bischoff, Randall E. Greer, and Antonio O. Luistro.
Science, Vol 167, No 3922, p 1245-1246, Feb 1970. 2 p, 1 fig, 7 ref. NSF Grant GA 11490.

Descriptors: *Connate water, *Cores, *Test procedures, *Physicochemical properties, Sampling, Porous media, Water chemistry, Temperature, Sediments, Laboratory tests, Anion exchange, Potassium, Chlorides, Magnesium.
Identifiers: *Pore water chemistry, *Marine sediments, Interstitial waters.

To determine that potassium enrichments in interstitial water from marine sediments are due, in part, to temperature effects from sampling and squeezing, as recent studies indicated, a series of duplicate samples were tested using freshly collected core and then squeezing one set at in situ temperature and the other at laboratory temperature. Warming the samples to room temperatures prior to extraction of water from the sediments accounts for apparent enrichments of potassium ion (13.3%) and chloride ion (1.4%) and depletions of magnesium ion (2.5%) and calcium ion (4.9%). These differences result from changes in ion-exchange selectivity as a function of temperature. It is concluded that for accurate analyses of pore water chemistry, extraction of the pore water must be done at the in situ temperature of the sediment. (Lang-USGS)
W70-04075

SODIUM HAZARD OF BICARBONATE IRRIGATION WATERS,
California Univ., Riverside. Dept. of Soils and Plant Nutrition.
P. F. Pratt, and F. L. Bair.
Soil Science Society America Proceedings, Vol 33, No 6, p 880-883, Nov-Dec 1969. 4 p, 5 fig, 2 tab, 13 ref.

Descriptors: *Irrigation water, *Bicarbonates, *Sodium, Calcium carbonate, *Water chemistry, Acidity, Soils, Zeolites, Evapotranspiration, Water quality, Precipitation (Atmospheric), Lysimeters.
Identifiers: *Sodium hazard, Precipitation index.

Results of a 6-year lysimeter experiment show that the water quality value based on the precipitation index (PI) for calcium carbonate satisfactorily estimated the effect of the water on the composition of saturation extracts of soil samples, except where Na precipitation occurred. Essential conditions for Na precipitation, presumably as a zeolite, were a pH above 8.6 and time for dissolution of reactants from the soil and formation of the product. Tree trunk diameter growth by lemon trees (Citrus lemons) and evapotranspiration were linearly correlated with water quality values based on PI. (Carstea-USGS)
W70-04104

THE CURRENT TRITIUM CONTENTS OF NATURAL WATERS,
Akademiya Nauk SSSR, Moscow. Institut Geokhimii i Analiticheskoi Khimii.
A. P. Vinogradov, A. L. Devirts, and E. I. Dobkina.
Trans from Geokhimiya, No 10, p 1147-1162, 1968. Geochemistry International, Vol 5, No 5, p 952-966, 1968. 15 p, 4 fig, 5 tab, 50 ref.

Descriptors: *Tritium, *Surface waters, Fallout, Tracers, Water chemistry, Water quality, Hydrogen, Water analysis, Radiochemical analysis.
Identifiers: *USSR, Pakhva River, Oka River, Moscow.

Tritium analyses were made on a number of water and plant samples collected in the western USSR. The analyses were made by gas-proportional counting. The counters were steel or copper in conventional steel shields with a ring of geiger guard counters in anticoincidence with the main counter. The tritium content of atmospheric precipitation and water vapor near Moscow ranged from 400 to 800 TU in 1966 and from 40 to 300 TU in 1967. Lakes in the central and NW USSR ranged from 170 to 370 TU in 1967, while the Pakhva and Oka Rivers near Moscow in September 1967 had 65 and 34 TU, respectively. (Knapp-USGS)
W70-04116

NITROGEN-FIXING BLUE-GREEN ALGAE IN SWEDISH SOILS,
Uppsala Univ. (Sweden). Inst. of Physiological Botany.
Ulf Granhall, and Elisabet Henriksson.
Oikos, Vol 20, No 1, p 175-178, 1969. 3 tab, 15 ref.

Descriptors: *Nitrogen, *Nitrogen fixation, *Soil algae, Soils, Soil tests, Hydrogen ion concentration, Soil moisture.
Identifiers: *Blue-green algae, Acetylene reduction technique, Soil nitrogen, Heterocysts, Swedish soils, Nitrogen-fixing algae.

The relative abundance of nitrogen-fixing algae in different Swedish soils was studied in situ and in monocultures using the acetylene reduction technique. Sampling sites were distributed over entire Sweden and Gotland Island. Regardless of geographic location, soil properties exerted decisive influence on the presence and density of the organisms. Soils with reaction between pH 3 and pH 5 were free from blue-green algae; their occurrence was also greatly reduced by deficiency of moisture and low supply of nutrients. An abundant occurrence of nitrogen-fixing forms, including genera of Nostoc, Anabaena, Calothrix, and Tolypothrix, was confined to alkaline or slightly acid, moist soils which are low in combined nitrogen. The organisms are obviously of little importance to forest soils of the investigated region. (Wilde-Wisconsin)
W70-04186

A CRITICAL EVALUATION OF THE TROPHIC LEVEL CONCEPT. I. ECOLOGICAL EFFICIENCIES,
Wisconsin Univ., Madison. Dept. of Zoology.
Daniel G. Kozlovsky.
Ecology, Vol 49, No 1, p 48-60, 1968. 14 fig, 7 tab, 27 ref.

Descriptors: *Biomass, *Energy transfer, Trophic level, Efficiencies.
Identifiers: Energy retention, Bioactivity, Ecological efficiencies, Net community output, Eutrophic stage equilibrium.

A scheme of ecological efficiencies which equate terminology of various authors and the concepts of 'community efficiency' and 'community productivity' and proposes several new ways of calculating the net output taking into account all trophic levels or populations. The terms 'community efficiency of energy transfer' and 'community efficiency of energy retention' are suggested. (Wilde-Wisconsin)
W70-04251

0-18/0-16 RATIOS IN SNOW AND ICE OF THE HUBBARD AND KASKAWULSH GLACIERS,
Alberta Univ., Edmonton. Dept. of Geology; and Alberta Univ., Edmonton. Dept. of Physics.
D. S. Macpherson, and H. R. Krouse.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 180-194, 1967. 15 p, 13 fig, 9 tab, 25 ref.

Descriptors: *Glaciers, *Ice, *Snow, Oxygen, Analytical techniques, Precipitation (Atmospheric), Snowmelt, Tracers.
Identifiers: *Hubbard Glacier, *Kaskawulsh Glacier, St. Elias Mountains.

One hundred samples collected from the Hubbard and Kaskawulsh glaciers in the St. Elias Mountains during the summer of 1963 were analyzed for 0-18 and 0-16. The delta 0-18/0-16 values ranged from -18 to -29 (SMOW), with an average of about -23. Pits that were studied before extensive melting showed definite trends, with the more negative values corresponding to winter precipitation. Pits studied later in the season had the seasonal trend masked by the action of downward percolating meltwaters. The average of all pits and boreholes studied above the firn line gave no indication of an altitude variation larger than the sampling error. A longitudinal profile below the firn line showed much scatter in the 0-18 value, but the average trend was a decrease in going down-glacier from the firn line to the terminus. A transverse profile below the firn line which sampled 3 main ice streams gave remarkably consistent values near the margins, whereas the stream centers had decidedly more positive or negative values. These results are considered in terms of accepted modes of glacier flow. Precipitation studies exhibited much scatter and did not show the expected altitude variation. Comparison of the over-all data with that of other workers shows a number of consistencies. This comparison also suggests that much of the precipitation in the area is derived from the Pacific Ocean rather than from inland sources. (Carstea-USGS)
W70-04260

U.S. GEOLOGICAL SURVEY WATER-QUALITY DATA IN THE WILLAMETTE BASIN, OREGON, 1910-64,
Geological Survey, Portland, Oreg.
R. J. Madison.
Geological Survey Basic-Data Release, Mar 1966. 40 p, 3 fig, 2 tab, index.

Descriptors: *Water quality, *Oregon, Water chemistry, Water analysis, Data collections, Hydrologic data, Streams, Rivers, River basins, Water pollution.
Identifiers: Willamette River basin (Ore).

This report presents chemical analyses of water samples collected in the Willamette Basin, Oreg., and analyzed by the U.S. Geological Survey. All data collected through September 1964 have been tabulated through the Survey's Automatic Data Processing system. These tabulations have been prepared to make the data available to all agencies working on the comprehensive study of the Willamette Basin. Because the Sandy River basin is a part of the study area, analyses of samples from that basin are also included. (Knapp-USGS)
W70-04261

CHANGES IN THE CLAY-WATER SYSTEM WITH DEPTH, TEMPERATURE, AND TIME,
Georgia Inst. of Tech., Atlanta. Water Resources Center.
C. E. Weaver, and Kevin C. Beck.
Available from the Clearinghouse as PB-189 168, $3.00 in paper copy, $0.65 in microfiche. Water Resources Center, Georgia Institute of Technology WRC-0769, Oct 1969. 95 p, 6 tab, 24 fig, 101 ref. OWRR Project A-008-GA

Descriptors: *Montmorillonite, *Illite, *Clay minerals, *Water chemistry, *Geochemistry, *Cations, Cation exchange, Cation adsorption, Anion exchange, Ion exchange, Ion transport, Hydrogen ion concentration, Pore pressure, Organic matter, Sodium, Potassium, Calcium, Manganese, Aluminum, Calcite.
Identifiers: *Interstitial water, *Interstitial ions.

An objective of the study was to determine the changes in the chemistry of the interstitial water of muds during burial. Side wall core samples of mud, ranging from 4,233 feet to 16,450 feet, were obtained from a well in the Mississippi Delta area. Analysis showed that the concentration of cations in the interstitial waters was approximately twice that of sea water. Na and K were more abundant and Ca and Mg less abundant than in sea water. K and Mg increase with depth. The anion concentration is HCO3 much greater than SO4 much greater than Cl. Cl is flushed from the system and systematically decreases with depth. SO4 is concentrated by filtering and HCO3 is created by the decomposition of organic matter and calcite. Na is the major exchange cation in the shallow samples and Ca in the deeper samples. Most of the exchangable Mg is gone at a depth of 4,233 feet. With depth montmorillonite layers alter to illite and chlorite layers even though the Al2O3/K2O and Al2O3/MgO ratios remain constant. There is some rearrangement of the elements in the solid phase but for complete conversion of montmorillonite to illite and chlorite, K and Mg must be added from below. (Conway-Georgia Tech)
W70-04295

ISOTOPIC COMPOSITION AND ORIGIN OF THE ATMOSPHERIC WATER VAPOR IN THE REGION OF LAKE LEMAN (IN FRENCH),
Pisa Univ. (Italy). Lab. of Nuclear Geology.
J.-Ch. Fontes, and R. Gonfiantini.
Earth and Planetary Science Letters, Vol 7, No 4, p 325-329, Jan 1970. 5 p, 1 fig, 3 tab, 9 ref.

Descriptors: *Evaporation, *Lakes, *Stable isotopes, *Tracking techniques, Water vapor, Mixing, Meteorology, Chemistry of precipitation, Distribution patterns, Humidity, Hydrologic cycle.
Identifiers: Lake Leman (Switzerland).

The isotopic composition of the atmospheric water vapor over Lake Leman changes regularly with the distance from the water surface. This fact indicates that the vapor results from a mixing of the vapor evaporated from the lake with the regional atmospheric vapor. The fractions of these two vapors of different origin are evaluated in each sample on the basis of the isotopic data. The method permits estimation of the climatic zone of influence of the lake in the atmosphere.
W70-04304

CHEMICAL AND RADIOCHEMICAL ANALYSES OF WATER FROM STREAMS, RESERVOIRS, WELLS, AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO,
Geological Survey, Denver, Colo.
J. D. Larson, and W. A. Beetem.
Geological Survey Open-file Report, Jan 1970. 16 p, 2 fig, 6 tab, 6 ref. Contract No AT (29-2)-474 USAEC.

Descriptors: *Hydrologic data, *Colorado, *Water wells, *Streams, *Water quality, Data collections, Tritium, Water pollution sources, Nuclear explosions, Radiochemical analysis.
Identifiers: Project Rulison.

Wells were inventoried and sampled, and a network of 21 surface-water sampling stations was established in the Rulison area, Colorado, to determine changes in tritium content and water chemistry attributable to the Rulison project, an experiment in stimulating natural gas production by a nuclear explosion. Locations of the sampling sites, pre-explosion chemical analyses of surface waters and groundwaters, well records, cistern records, and spring records are tabulated. (Knapp-USGS)
W70-04307

RECENT DISSOLVED-OXYGEN MEASUREMENTS IN THE GULF OF MEXICO DEEP WATERS,
Office of Naval Research, Washington, D.C.; Texas A and M Univ., College Station. Dept. of Oceanography; and National Science Foundation, Washington, D.C.
Worth D. Nowlin, Jr., David F. Paskausky, and Hugh J. McLellan.
Journal of Marine Research, Vol 27, No 1, p 39-44, Jan 15, 1969. 6 p, 4 fig, 1 tab, 4 ref. ONR Contract Nonr 2119 (04).

Descriptors: *Dissolved oxygen, *Gulf of Mexico, Water chemistry, Water quality, Water temperature, Sea water.
Identifiers: Yucatan Basin.

Because in 1963 it was suggested that rather large gradients in dissolved oxygen exist in the Gulf of Mexico below a sill depth of between 1500 m and 1900 m, measurements were made on three cruises during 1966 and 1967. No clearly discernible horizontal variation in dissolved oxygen was found in these waters. Only slight vertical oxygen gradients were measured below the sill depth; the mean value obtained is approximately 5.0 ml/liter. The data obtained in 1966 and 1967 are compared with data obtained on 7 previous cruises in 1935, 1958, 1959, 1962, and 1964. (Knapp-USGS)
W70-04317

REDEFINITION OF SALINITY,
Scientific Committee on Oceanic Research (Gt. Brit.); International Council for the Exploration of the Seas; and International Association for the Physical Sciences of the Ocean.
For primary bibliographic entry see Field 07A.
W70-04318

DIFFERENCES IN SOIL CHEMISTRY INDUCED BY EVAPORATION AND FLOW OF GROUNDWATER,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 02G.
W70-04340

DETERMINATION OF MERCURY IN NATURAL WATERS BY COLLECTION ON SILVER SCREENS,
Geological Survey, Denver, Colo.
Margaret E. Hinkle, and Robert E. Learned.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D251-D254, 1969. 4 p, 6 tab, 12 ref.

Descriptors: *Water analysis, *Trace elements, *Geochemistry, Water chemistry, Separation techniques, Analytical techniques, Spectrophotometry.
Identifiers: Mercury analysis.

A method for determining nanogram quantities of mercury in natural waters is described wherein mercury is collected on silver screens immersed in samples acidified with hydrochloric acid and the collected mercury is measured by heating the screens in a mercury-vapor absorption detector. As little as 10 nanograms of Hg in 100 ml of water can be detected by this procedure. The speed and simplicity of this method permit its use in hydrogeochemical surveys where mercury is utilized as a pathfinder element. (Knapp-USGS)
W70-04341

EXTRACTION OF DISSOLVED CARBONATE SPECIES FROM NATURAL WATER FOR CARBON-ISOTOPE ANALYSIS,
Geological Survey, Denver, Colo.; and Geological Survey, Washington, D.C.
Jim D. Gleason, Irving Friedman, and Bruce B. Hanshaw.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D248-D250, 1969. 3 p, 1 fig, 2 tab, 3 ref.

Descriptors: *Water analysis, *Stable isotopes, *Radioisotopes, *Carbon radioisotopes, *Separation techniques, Water chemistry, Chemical precipitation, Filtration.
Identifiers: Carbon-13 analysis.

The best method for separating the dissolved carbonate species from natural water in order to determine C-13 value of carbon in the aqueous phase appears to be a direct-precipitation method. This method consists of adding ammonium hydroxide strontium chloride solution directly to the sample of natural water to be analyzed. The strontium carbonate thus formed precipitates, and is subsequently separated, dried, and analyzed for C-13. The ammonium hydroxide strontium chloride solution can absorb carbon dioxide from the air; it is therefore extremely important that both the water sample and the prepared solution not be exposed to the air during handling and filtration. Exposure for a few minutes will cause contamination and give incorrect C-13 values. (Knapp-USGS)
W70-04342

A NEUTRON SCATTERING STUDY OF WATER AND IONIC SOLUTIONS,
Union Carbide Corp., Tuxedo, N.Y.
For primary bibliographic entry see Field 01B.
W70-04347

2L. Estuaries

POTOMAC ESTUARY MATHEMATICAL MODEL,
Federal Water Pollution Control Administration, Annapolis, Md. Chesapeake Field Station.
For primary bibliographic entry see Field 05B.
W70-04077

NITRATE DISTRIBUTION IN THE SUBARCTIC NORTHEAST PACIFIC OCEAN,
Washington Univ., Seattle. Dept. of Oceanography; and Fisheries Research Board of Canada, Nanaimo, British Columbia. Pacific Oceanographic Group.
G. C. Anderson, T. R. Parsons, and K. Stephens.

Deep-Sea Research, Vol 16, p 329-334, 1969. 3 fig, 13 ref.

Descriptors: *Nitrates, *Distribution, *Pacific Ocean, *Subarctic, Seasonal, Phytoplankton, Surfaces, Depth, Primary productivity, Nutrients, Thermocline, Washington, Oregon, Coasts, Gulfs, Alaska, Velocity, Chlorophyll, Light intensity.
Identifiers: *Northeast Pacific Ocean, Isohaline zone, Bering Strait, West wind drift.

Data are presented on nitrate distribution in the subarctic Northeast Pacific Ocean. Data on other oceanographic parameters were collected simultaneously with the nitrate information and have confirmed the general oceanographic features governing production. Samples were collected during 1966 and 1967 at Ocean Weather Station P, on cruises in the North Pacific Ocean during 1964-1967 primarily for fish tagging, and during cruises of the R V Brown Bear in 1964 and 1965 off the Washington and Oregon coasts, eastward. Over most of the area nitrate is present at the surface throughout the year at a concentration above that limiting phytoplankton growth. Within coastal regions and south of about 45 degrees north, nitrate may become depleted during the spring and summer. It is suggested that maintenance of high nitrate concentrations over much of the area is due to relatively intensive entrainment of deep water into the upper zone coupled with a slow rate of nitrate removal by primary producers. Nitrate depletion in the southern area may be explained by less intensive entrainment of deep water and utilization of nutrients by a subsurface phytoplankton maximum beneath the seasonal thermocline. (Jones-Wisconsin)
W70-04188

ON THE DISTRIBUTION OF MAJOR NUTRIENTS AND PHYTOPLANKTON IN THE TAMAR ESTUARY,
Brussels Univ. (Belgium). Laboratoire de Botanique Systematique et d'Ecologie.
J. P. Mommaerts.
Journal of the Marine Biological Association of the United Kingdom, Vol 49, No 3, p 749-765, 1969. 7 fig, 2 tab, 30 ref, append.

Descriptors: *Distribution, *Nutrients, *Phytoplankton, Salinity, Phosphates, Nitrates, Silicates, Seasonal, Nannoplankton, Tidal waters, Temperature, Diatoms, Dinoflagellates, Marine algae, Littoral, Benthic flora, Brackish water, Fresh water, Scenedesmus, Trace elements.
Identifiers: *Tamar Estuary (England), Ionic composition, Exchange ratio, Evolution, Ultraplankton, Net-phytoplankton, Composition, Skeletonema, Prorocentrum, Nitzschia, Cryptomonas, Gymnodinium, Flagellates, Melosira, Navicula, Thalassiosira, Gyrodinium, Heterocapsa, Peridinium, Asterionella, Chaetoceros, Synedra, Corethron, Rhizosolenia, Dinophysis, Phaeocystis, Gonyaulax, Anabaena, Achnanthes, Cocconeis.

The Tamar estuary (England) has been surveyed from March to September 1968 for major ecological factors--especially chemical--and the nature and succession of phytoplanktonic populations in the eu-, poly- and mesohaline zones. Salinity distributions and variations were measured to provide a preliminary picture of the general circulation. Tidal flows appear to have most effect on water movement. Importance of flow and exchange ratios is emphasized. Major nutrients (phosphates, nitrates, and silicon) have been analyzed and peculiar patterns of vertical distribution are discussed. Decrease in nutrients content--with salinity 28 parts/thousand as index--is inversely correlated to the spring and summer blooming of nannophytoplankton. Distribution and evolution of various groups of phytoplankton are given. Comparison with open-sea data indicates which of the microphytoplankton is indigenous; most of the species borne from the sea cannot survive the salinity change. It is suggested that the exchange ratio controlling growth is low in the Tamar (great abundance and diversity of species, low flow ratio and the Sound as transitory region), but further studies on circulation patterns are needed to clarify this assumption. (Jones-Wisconsin)
W70-04192

PHYTOPLANKTON AND RELATED WATER-QUALITY CONDITIONS IN AN ENRICHED ESTUARY,
Geological Survey, Tacoma, Wash.
Eugene B. Welch.
Journal Water Pollution Control Federation, Vol 40, No 10, p 1711-1727, 1968. 10 fig, 27 ref.

Descriptors: *Analytical techniques, *Aquatic algae, *Aquatic microbiology, *Aquatic productivity, Biochemical oxygen demand, Cycling nutrients, Diatoms, Environmental effects, Essential nutrients, Eutrophication, Light intensity, Light penetration, Limnology, Nitrogen compounds, Nuisance algae, Nutrient requirements, Nutrients, Phosphorus compounds, Photosynthetic oxygen, Physiological ecology, Phytoplankton, Estuaries, Pollutant identification, Sewage, Sewage disposal, Sewage effluents, Water pollution control, Water pollution effects, Water pollution sources.
Identifiers: *Seattle (Wash), Renton Treatment Plant, Duwamish estuary (Wash).

Ammonia, soluble phosphate, and total phosphate concentrations were observed to increase in the Duwamish estuary, Washington, following initial discharge of effluent from the Renton Treatment Plant at Seattle. A phytoplankton bloom dominated by marine species occurred in the lower estuary in August 1965, about 1.5 months following the nutrient increase. A bloom did not occur in 1964, prior to effluent discharge from the treatment plant, but some evidence shows that algal activity was great in August 1963. The nutrient increase in 1965 probably was not the sole factor causing the bloom during that summer because: (a) the pre-effluent nutrient concentrations in 1963 and 1964 were relatively high; (b) a bloom also occurred at the furthest downstream station where no increase in nutrients was apparent in 1965 over that of the preceding two years; (c) a bloom probably occurred in 1963, before the addition of nutrients from the plant; and (d) the bloom maximum did not occur in 1965 until about 1.5 months after the nutrient increase, when discharge and tidal exchange conditions were minimum. Bloom timing seemed related most closely to hydrographic conditions. (Fitzgerald-Wisconsin)
W70-04283

THE ECOLOGY OF SHALLOW WATER MEIOFAUNA IN TWO NEW ENGLAND ESTUARIES,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
John H. Tietjen.
Oecologia (Berl), Vol 2, p 251-291, 1969. 6 fig, 12 tab, 38 ref.

Descriptors: *Aquatic life, *Estuaries, Nematodes, Mollusks, Copepods, Amphipoda, Hydrogen ion concentration, Biomass, Diatoms, Chlorophyta, Chrysophyta, Bottom fauna, Nematodes, Periphyton.
Identifiers: *Meiofauna, Taxa, Subtidal meiofauna, Maldanid polychaetes, Rose Bengal, TAF, Triethanolamine formalin, Ostracods, Polychaetes, Lamellibranchs, Chlorophyll a, Turbellaria, Hydrozoa, Epigrowth feeders, Epiphytic algae, Pennate diatoms, Filter-feeding Harpactaicoidea, Vertical distribution, Niantic River estuary (Conn), Pettaquamscutt River estuary (R I).

A study made between October 1964 and October 1965, of distribution and abundance of shallow subtidal meiofauna (passing a 0.50 millimeter mesh screen and retained on a 0.074 millimeter mesh screen) in four habitats of Niantic and Pettaquamscutt estuaries in southeastern New England. Temporal changes in major taxa to changes in environment and seasonal changes with possible causes are presented. Total numbers of meiofauna varied between 1,184 and 5,163 organisms/10 square centimeters, and wet weights between 8.5 and 62.5 milligram/10 square centimeter. Nematodes were the dominant group, comprising between 58 and 90% of total fauna and 64% of the total biomass. Among the nematodes, epigrowth-feeding species were dominant at all four stations, showing marked seasonal changes in species composition. Epigrowth-feeding species reached maximum density in spring and summer and deposit and omnivorous-feeding species in fall and winter. Polychaetes, amphipods, and lamellibranchs were most abundant in the summer, while Ostracods were abundant in late summer, fall, and winter in association with detritus increase. Harpactacoid copepods were inconsistent in their seasonal distributions. Approximately 80% of all meiofauna were found in the upper 3 centimeters of sediment. (Haskins-Wisconsin)
W70-04288

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME I.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04299

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME II.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04300

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME III.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04301

ROLE OF SALT WEDGE IN BAR-FINGER SAND AND DELTA DEVELOPMENT,
Northeastern Illinois State Coll., Chicago. Dept. of Geology.
For primary bibliographic entry see Field 02J.
W70-04306

DESCRIPTION OF A FREELY DROPPED INSTRUMENT FOR MEASURING CURRENT VELOCITY,
Nova Univ., Fort Lauderdale, Fla. Physical Oceanographic Lab.
For primary bibliographic entry see Field 07B.
W70-04310

USE OF AIR TO INFLUENCE GROUNDWATER MOVEMENT,
Dames and Moore, San Francisco, Calif.
For primary bibliographic entry see Field 02F.
W70-04358

AN ELECTRO-OPTICAL SYSTEM FOR MEASUREMENT OF MEAN AND STATISTICAL PROPERTIES OF SEDIMENT SUSPENSIONS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 02J.
W70-04492

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

OPERATION OF A REVERSE OSMOSIS DESALINATION UNIT AT WEBSTER, SOUTH DAKOTA,
Aerojet-General Corp., El Monte, Calif.

Warren H. Bossert, and Gordon A. Fluke.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $1.50. Office Saline Water Research and Development Progress Report No 427, May 1969. 107 p, 14 fig, 8 tab, 3 ref, 6 append. OSW Contract No 14-01-0001-1181.

Descriptors: *Water quality, *Desalination processes, *Reverse osmosis, Brackish water, Wells, Membranes, Deposition (Sediments), Flow, Operation and maintenance, Statistical methods, Model studies, Regression analysis, Potable water.
Identifiers: US Public Health Service, *Drinking water standards.

The quality of the product water obtained through reverse osmosis of brackish well waters in Webster, South Dakota met the U.S. Public Health Service Drinking Water Standards. A sharp decline in flow rate was observed during the first week of operation. This is believed to be a result of sediment deposition on the membranes. The original flow rate was not restored in spite of using various types of feedwater pretreatments. Maintenance of the plate and frame osmotic unit required less than 1% of the available operating time. Statistical analysis by fitting regression models to predict product-quantity and product-quality responses was made on a representative set of data. (Carstea-USGS)
W70-04082

SYNTHESIS AND EVALUATION OF NEW MEMBRANE CANDIDATES FOR APPLICATION IN REVERSE OSMOSIS,
Peninsular ChemResearch, Inc., Gainesville, Fla.
Thomas W. Brooks, and Carl L. Daffin.
Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price 50 cents. Office of Saline Water Research and Development Progress Report No 460, Oct 1969. 33 p, 1 fig, 11 tab, 31 ref. OSW Contract No 14-01-0001-1260.

Descriptors: *Membranes, *Membrane processes, *Reverse osmosis, *Desalination processes, Cellulose, Osmotic pressure, Sodium chloride, Hardness (Water), Permeability, Performance, Compaction, Selectivity.
Identifiers: *Syndiotactic membranes, Acrylonitrile.

A noncellulosic synthetic polymer was shown to possess osmotic transport characteristics comparable in all respects to dense cellulose acetate. Syndiotactic poly (vinyl alcohol) membranes showed rather poor selectivity for aqueous sodium chloride feed solutions. However these membranes have shown promise for hard water applications. The attempts to improve their selectivity by grafting with acrylonitrile were not successful. The effects of grafting appeared to be a decrease in water permeability and an increase of compaction resistance. (Carstea-USGS)
W70-04083

AN EXPERIMENTAL STUDY OF THE STRUCTURE, THERMODYNAMICS AND KINETIC BEHAVIOR OF WATER,
Midwest Research Inst., Kansas City, Mo.
For primary bibliographic entry see Field 01A.
W70-04085

DEVELOPMENT OF WATER PURIFICATION SYSTEMS BASED ON REVERSE OSMOSIS,
Pratt and Whitney Aircraft, East Hartford, Conn.
R. C. Ellington.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $2.25. Office of Saline Water Research and Development Progress Report No 410, Apr 1969. 154 p, 76 fig, 27 tab, 7 ref, 4 append. OSW Contract No 14-01-0001-1113.

Descriptors: *Desalination processes, *Membranes, *Reverse osmosis, Water purification, Brackish water, Filtration, Bacteria, Scaling, Porous media, Performance, Hydrodynamics.
Identifiers: Polarization effects, Feedwater.

The performance of compact desalination membrane cartridges consisting of three composite membranes with variable surfaces was tested. The concentration polarization effects were very small. Reverse-osmosis membranes reinforced with nylon cloth were also tested for brackish waters. Feedwater pretreatment, such as filtration and bacteria removal, should be incorporated into all test systems as membrane fouling and scale buildup may affect membrane performance. Compaction studies should be extended to determine if membrane performance is either linear or logarithmic with respect to time. An endurance test performed on the compact cartridge and on individual membranes should be between 1,500 and 5,000 hours. The hydrodynamics of a number of porous support materials and structures were evaluated. (Carstea-USGS)
W70-04086

THE SECONDARY REFRIGERANT FREEZING PROCESS: A MATHEMATICAL STUDY,
Research Triangle Inst., Durham, N.C.
John C. Orcutt, Forest O. Mixon, and Francis J. Hale.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC - Price $1.25. Office Saline Water Research and Development Progress Report No 365, July 1968. 158 p, 23 fig, 11 tab, 40 ref, 6 append. OSW Contract No14-01-0001-960.

Descriptors: *Desalination processes, *Mathematical models, *Freezing, Economics, Analog computers, Crystal growth, Pilot plants, Temperature, Operating costs, Operation and maintenance, Columns, Optimization.
Identifiers: *Secondary refrigerant freezing process.

Mathematical models of the major system components were used to describe the secondary refrigerant freezing desalination process. The operational-design economics of a freezing process and the prediction of the best operating conditions were studied by mathematical equations with the aid of computers. The mixing characteristics of the freezer and the formation of crystals were studied in pilot plant experiments. A mathematical model for wash column operation was made with the aid of laboratory experiments on a small, rectangular wash column. Process operation economics were largely dependent upon the temperature maintained in the freezer and the overall difference in refrigerant and equilibrium temperature. The analog computer substantiated the findings of the dynamic analysis of the freezer. (Carstea-USGS)
W70-04088

THE FREEZING PROCESSES: BUTANE HYDRATES AND ANISOTROPIC POROUS MEDIA,
Syracuse Univ., N.Y.
Allen J. Barduhn, Olivier S. Rouher, and Daniel J. Fontugne.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC - Price $0.30. Office Saline Water Research and Development Progress Report No 366, p 1-15, Oct 1968. 15 p, 3 fig, 6 tab, 11 ref. OSW Grant No 14-01-0001-1135.

Descriptors: *Freezing, *Hydrate processes, *Desalination processes, Porous media, Hydrates, Permeability, Salts, Temperature, Thermodynamic behavior.
Identifiers: *Butane hydrates.

N-butane does not form a hydrate by itself at atmospheric pressures. The phase diagram for pure iso-butane hydrate shows the critical decomposition conditions to be 1.88 deg C and 1256 mm. The other thermodynamic properties studied were the heat of formation, the depression of the formation temperatures by salt, and the hydrate composition. The hydrate-forming capabilities of mixtures of iso and normal butane were determined. The design, construction and testing of an improved device for determining permeabilities of porous beds in two directions are discussed. (Carstea-USGS)
W70-04089

DEVELOPMENT OF ULTRATHIN SKIN MEMBRANES-HEMA POLYMERS,
Massachusetts Inst. of Tech., Cambridge.
A. S. Hoffman, and M. Modell.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $0.55. Office Saline Water Research and Development Progress Report No 374, Dec 1968. 30 p, 10 fig, 8 tab, 13 ref. OSW Grant No 14-01-0001-1256.

Descriptors: *Reverse osmosis, *Desalination processes, *Membranes, Sorption, Membrane processes, Water transfer, Diffusion, Diffusivity, Permeability.
Identifiers: Desalination membranes, N-methylol acrylamide, Acrylic acid, Ethyl acrylate, Trimethylol propane.

A new class of desalination membranes has been developed, characterized and tested under reverse osmosis conditions. Prepared by polymerizing mixtures of N-methylol acrylamide, acrylic acid, ethyl acrylate and trimethylol propane trimethacrylate followed by heat treatment, the membranes are essentially homogeneous, averaging about 6 mills in thickness. The membranes were characterized by measuring their sorption of water and salt when immersed in salt solution at ambient conditions. Reverse osmosis performance was evaluated at various pressures and salt concentrations. Best results indicate performance capabilities slightly better than dense cellulose acetate (39.8% acetylated) under comparable conditions. Salt and water transport mechanisms are interpreted in terms of solution at the membrane interface followed by activated diffusion of primary water or secondary water and its salt through the membrane. In terms of this model, certain changes in membrane composition or heat treatment cause much sharper drops in salt and secondary water diffusivities. This analysis permits prediction of new membrane compositions which should exhibit higher fluxes and even better permselectivity to water over salt. (Carstea-USGS)
W70-04090

PHYSICAL PROPERTIES OF SEA WATER SOLUTIONS: HEAT CAPACITY,
National Engineering Lab., East Kilbride (Scotland).
For primary bibliographic entry see Field 01A.
W70-04325

DESALINATION BY FREEZING - AN INVESTIGATION OF ICE PRODUCTION FROM BRINE IN A CONTINUOUS CRYSTALLIZER,
Massachusetts Inst. of Tech., Cambridge.
T. K. Sherwood, P. L. T. Brian, and A. F. Sarofim.
Available from Superintendent of Documents, U S Government Printing Office, Wash, D C - Price $1.25 per copy. Office of Saline Water Research and Development Progress Report No. 474, Sept 1969. 145 p, 27 fig, 9 tab, 60 ref, 5 append. OSW Grants Nos 14-01-0001-546, 14-01-0001-1719.

Descriptors: *Desalination processes, *Freezing, *Crystal growth, *Ice, Brines, Instrumentation, Permeability, Slurries, Particle size, Particle shape, Heat transfer, Nucleation, Porosity.
Identifiers: Continuous crystallizer, Ice beds.

Crystallizer operation and the suitability of the ice product for washing to remove brine in an ice-piston wash column desalination process were investigated. The permeability of ice beds formed from the ice slurries was measured. The ice particles have a disk-like shape with a thickness-to-diameter ratio of about 0.34. Most of the ice particles have a diameter between 0.6 and 0.8 mm, with

very few particles smaller than 0.4 mm or larger than 2 mm. The principal thermodynamic loss in freezing is due to the temperature difference required to transfer heat from brine to refrigerant. Permeabilities of ice beds formed from the product slurries increased sharply with bed porosity. Somewhat higher permeabilities were found at the highest slurry densities. Population balance, growth rates and nucleation rates of ice particles are also discussed. (Carstea-USGS)
W70-04346

3B. Water Yield Improvement

HYDROLOGICAL DOCUMENTATION FOR THE EXPLOITATION OF RESERVOIRS IN PERMEABLE SOLID ROCKS FOR THE PURPOSE OF ARTIFICIAL INFILTRATION,
Hydraulic Research Inst., Prague (Czechoslovakia).
Vaclav Zajicek.
Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 124-131, 1967. 8 p, 4 fig, 1 tab, 5 ref.

Descriptors: *Hydrologic data, *Surveys, *Data collections, *Reservoir design, *Reservoir leakage, Water storage, Aquifers, Aquifcludes, Artesian wells, Water yield, Groundwater movement, Reservoirs, Dams, Surface-groundwater relationships.
Identifiers: Czechoslovakia.

An approach to choosing valley sites for storage reservoirs is outlined. In the representative area of Czechoslovakia a dense network of hydrogeological probes was developed covering an area of several square kilometers, to study the permeable layer and its discharge in large springs at defects in the artesian ceiling. Other hydrological surveys supply data on the direction and velocity of flow, on the filtration and storage capacity of the rocks, and also on their effect on the water quality. This proves the feasibility of dual storage with the construction of impounding reservoirs and other similar reservoirs in the infiltration zone of some aquifers if the filtration losses appear as a positive item in the budget of artesian aquifers. A combination of surface and underground storage has a favorable effect also from the point of view of evaporation. (Knapp-USGS)
W70-04118

THE STORAGE CAPACITY IN THE DUNE-WATER CATCHMENT AREA OF AMSTERDAM AND ITS EFFECT ON THE WATER QUALITY,
Municipal Waterworks of Amsterdam (Netherlands).
K. D. Venhuizen.
Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 109-123, 1967. 15 p, 2 fig, 10 chart, 1 tab.

Descriptors: *Recharge, *Sands, *Water yield, *Water quality, Aquifers, Dunes, Water table, Canals, Drainage, Water levels, Water-level fluctuations, Saline water intrusion, Water storage, Induced infiltration, Surface-groundwater relationships.
Identifiers: *Netherlands.

The dunewater catchment area of Amsterdam is situated south of Zandvoort and covers approximately 3650 ha. Extraction of water was started in 1853 by means of open canals, and later by means of wells. By 1915 the amount of the extraction equaled the total effective rainfall. After that more water was extracted than percolated in the area. Since 1957 part of this area has been recharged with prefiltered water from the River Rhine, transported by a pipeline with a total length of 53 km. The infiltration water is captured by means of horizontal drains which carry it to the open canals. At present the infiltration area is about 430 ha and the capacity is 70 million cu m a year. In another part of the dunes storage canals have been built with a total storage capacity of 10 million cu m. The infiltration area combined with the storage capacity and the well-system have a probable aggregate capacity at 82 million cu m a year. By mixing the types of water it is possible to influence the quality of the final product. (Knapp-USGS)
W70-04121

SAGEBRUSH CONVERSION TO GRASSLAND AS AFFECTED BY PRECIPITATION, SOIL, AND CULTURAL PRACTICES,
Geological Survey, Denver, Colo. Water Resources Div.
L. M. Shown, R. F. Miller, and F. A. Branson.
Journal of Range Management, Vol 22, No 5, p 303-311, Sept 1969. 9 p, 5 fig, 2 tab, 14 ref.

Descriptors: *Range management, *Land management, *Revegetation, *Vegetation establishment, *Sagebrush, Watershed management, Cultivation, Grasses, Grazing, Forages, Range grasses, Brush control, Vegetation regrowth.
Identifiers: Sagebrush conversion, Grass establishment.

The most successful conversions of sagebrush to crested wheatgrass, in areas of the Western United States that receive an average of 8 to 14 inches of precipitation annually, usually occur where the annual precipitation exceeds 10 inches and on soils having medium moisture-holding capacities. Conversion results were intermediate on coarse soils having low moisture-holding capacities and comparatively poor on fine soils having high moisture-holding capacities. Degree of grass establishment varied directly with the big sagebrush vigor-index. Grass production was lower on gravelly sites converted from black sagebrush than on nearby sites converted from big sagebrush. Cheatgrass hindered the establishment of crested wheatgrass in some places. Conversion results were poor on sites where greasewood or shadscale was mixed with sagebrush. These halophytes had usually re-established on the treated sites. (Knapp-USGS)
W70-04322

EFFECTS OF WEATHER MODIFICATION ON PLANT AND ANIMAL COMMUNITIES,
Michigan Univ., Ann Arbor. School of Natural Resources.
For primary bibliographic entry see Field 02B.
W70-04391

RATIONAL UTILIZATION OF MEXICO'S WATER RESOURCES (IN SPANISH),
Secretaria de Recursos Hidraulicos (Mexico).
For primary bibliographic entry see Field 06B.
W70-04408

3D. Conservation in Domestic and Municipal Use

COOPERATION BY CITIES OF 100,000 INHABITANTS AND MORE WITH DRAINAGE DISTRICTS, ETC., FOR FLOOD PROTECTION.

Mo Ann Stat secs 70.330 thry 70.360 (1952).

Descriptors: *Missouri, *Cities, *Drainage districts, *Sewers, Legislation, Local governments, Watershed management, Flood control, Watersheds (Basins), Punlic health, Environmental sanitation, Conveyance structures, Natural streams, Overflow, Flood damage, Eminent domain, Right-of-way, Assessments, Cost-benefit theory, Costs, Cost repayment, Stream improvement, Cost allocation, Levees, Construction.

Cities with more than one hundred thousand inhabitants amy contract with local drainage districts or other public corporations for cooperation or joint action in building sanitary and storm sewers in watersheds common to such cities and districts. These cities may also contract to construct levees or improve any natural watercourse to prevent overflow from injuring lands situated within their territorial limits. These cities may contract with the United States, private corporations, and any individuals owing lands subject to injury by overflow or in need of sewers. Where a watershed is located partially within an adjoining state, the preceeding activities may be carried on with the consent of the adjoining state if the public health and safety so require. These cities may acquire rights of way by purchase or eminent domain for any such sewers or watercourse improvements. The cities may pay for these works and rights of way out of their general funds or by imposition of special assessments upon benefited lands. (Schram-Florida)
W70-04230

MUNICIPALLY OWNED UTILITIES: CITIES SUPPLIED WITH WATER FROM OTHER CITIES.
Mo Ann Stat secs 91.050 thru 91.080 (1952).

Descriptors: *Missouri, *Water works, *Water supply, *Local governments, Public utilities, Pipelines, Water delivery, Contracts, Condemnation, Eminent domain, Condemnation value, Easements, Right-of-way, Water distribution (Applied), Cities.

Any city in the state which owns and operates a waterworks system may supply water to other municipalities and to persons beyond the corporate limits of the city. Any city having authority to maintain waterworks may procure water from another city for that purpose and may lay pipelines and install all machinery needed to convey the water from the supplying city. Every city to be supplied with water from another city may condemn a right of way to and from the supplying city. (Dearing-Florida)
W70-04466

WATER UTILITY COST TRENDS,
Dade County Water and Sewer Board, North Miami Beach, Fla.; Whitman, Requardt and Associates, Baltimore, Md.; and Cast Bay Municipal Utility District, Oakland, Calif.
Stanley L. Cohen, C. Ernest North, and Charles B. Adelman.
American Water Works Association Journal, Vol 60, No 2, p 129-134, February 1968. 6p, 2 ref.

Descriptors: *Costs, *Interest rates, *Financing, Inflation, Wages, Water supply, Budgeting, Fringe benefits, Labor, Investment, Management, Water rates, Profits, Debt, Industrial production, Population.
Identifiers: *Depreciation, *Trending method.

Three basic topics are discussed, the first being the interest rate costs in water utilities. The need for large amounts of capital for water treatment and supply facilities is stressed as well as the increasing cost of that capital. The dilemma that this poses to the water utility faced with artificially low water rates is discussed. The second section is concerned with depreciation and the problem of estimating depreciation with respect to the true purpose of depreciation, (i.e., to recover the original investment). The method currently in use is poor and the article proposes the trending method as producing better results. The third section deals with the cost of labor and material in water utilities. This final section discusses the rising cost of labor, the use of indexes, the cost effects of fringe benefits and the implications of inflation for water costs. (Murphy-Rutgers)
W70-04524

MUNICIPAL CORPORATIONS.

Ohio Rev Code Ann sec 717.01 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Cities, *Water works, *Sewers, Legislation, Wharves, Navigable waters, Sewage disposal, Waste water disposal, Drains, Ditches, Levees, Dams, Watershed management, Water supply.

Municipal corporations are empowered to: construct wharves and landings on navigable waters; acquire waterworks, which may extend beyond the municipal limits; construct sewers, disposal works, drains and ditches, construct and improve levees, dams waterfronts and any watercourse within its boundaries; and acquire land and water rights necessary for the protection of watersheds. (Douberley-Florida)
W70-04525

COMPARISON OF COSTS OF REMOTE CONTROL AND MANUAL OPERATION,
Gary-Hobart Water Corp., Gary, Ind.
For primary bibliographic entry see Field 06C.
W70-04528

WATER SUPPLY.

Mo Ann Stat sec 88.633 (1952).

Descriptors: *Missouri, *Water supply, *Water works, *Administration, Hydrants, Water allocation, Water conveyance, Water delivery, Water distribution, Water management (Applied), Water policy, Water rates, Water resources development, Local governments, Political aspects.

The city council of a third class city may make contracts for furnishing the city with water, fire hydrants and public fountains. No such contract shall be for more than twenty years. No contract is valid until ratified by vote of two-thirds of the qualified voters. The council is empowered to erect and maintain water works for the city and to regulate the rates charged for water. The council may acquire by condemnation, donation, or purchase lands necessary for the operation of water works. The council may grant the right to operate water works to any person or corporation. The granting of such right must be ratified by a majority of qualified voters. Contracts entered before enactment of this statute and not ratified by the voters are not invalidated by the statute. (Dye-Florida)
W70-04537

MUNICIPALLY OWNED UTILITIES: WATERWORKS.
Mo Ann Stat secs 91.593 thru 91.610 (1952).

Descriptors: *Missouri, *Water works, *Public utilities, *Local governments, Pipes, Buildings, Easements, Right-of-way, Condemnation, Condemnation value, Eminent domain, Water supply, Municipal water, Financing, Pumping plants, Compensation, Water distribution (Applied), Distribution systems, Contracts, Land tenure, Legislation.
Identifiers: *Revenue bonds.

Certain cities which own and operate a waterworks system may acquire and maintain property and facilities outside the city limits when necessary for connecting with emergency water supplies or for furnishing water to persons outside the city limits. These cities may issue revenue bonds, following specified procedures, for the repair or improvement of their waterworks systems. Every such city may take, hold, use, and dispose of real and personal property as necessary to provide waterworks for the city. No property may be taken or damaged, however, without payment of just compensation to the owner. (Dearing-Florida)
W70-04539

3E. Conservation in Industry

GEOLOGICAL SURVEYS AND WATER RESOURCES; GEODETIC SURVEYS.

Mo Ann Stat secs 256.010 thru 256.160 (1959), as amended, (Supp 1970).

Descriptors: *Missouri, *Geological surveys, *Water resources, *Administrative agencies, Groundwater, Mineralogy, Compensation, Costs, Federal government, Clays, Rocks, Natural gas, Maps. Conservation, Construction, Education, Damages, Water supply, Subsurface waters, Chemical analysis, Surface waters, Supervisory control (Power), Water resources development.
Identifiers: Penalties (Civil).

The Governor is authorized to appoint a competent state geologist to direct a geological survey. The state geologist may appoint assistants to make a thorough scientific, geological, and mineralogical study of the state. The Governor shall have general supervisory control of the Division of Geological Survey and Water Resources. All employees of the Division shall abstain from private consulting activities. Priorities in the Survey include studies of geological formations, mineral deposits, and the arrangement, composition and utilization of ores, clays, natural gas, surface and groundwaters, and other mineral substances. The state geologist is directed to prepare statistical reports and topographical maps, and to apply geologic engineering principles to problems of agriculture, conservation, and construction. He is also authorized to make a survey of the state's water resources. Information gathered shall be made available to the news media and educational institutions. The Division may authorize additional technical work, and may cooperate with federal agencies. Geodetic surveyors may enter state lands to effect the objects of the federal act. Compensation is to be paid for damages done by surveyors and procedures are set forth for determining adequate compensation. (Duss-Florida)
W70-04228

POWERS OF GAS, ELECTRIC OR WATER COMPANIES.

Mo Ann Stat secs 393.010 thru 393.030, 303.050 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Public utilities, *Electric power industry, *Water works, Legal aspects, Legislation, Cities, Industries, Water distribution (Applied), Urbanization, Utilities, Condemnation, Eminent domain, Construction, Electric power production, Right-of-way, Water conveyance, Water delivery, Consumptive use, Distribution systems, Water allocation (Policy).

Corporations organized to supply gas, electricity or water are authorized to set their poles, piers, abutments, wires and other fixtures along, across, or under any Missouri waters in such a manner as not to incommode the public use of such waters. Such corporations are authorized to lay and construct underground water mains across any Missouri streams for the purpose of furnishing water supply. Any corporation, company or individual proposing to supply any city, town, or village with water is authorized to take water from any non-navigable stream and to erect a dam thereon. Any such water corporation may acquire by condemnation sufficient lands to lay pipes for the conveyance of water in, over, or through lands situated beyond the water supply source. Any such water corporation may also acquire by condemnation sufficient lands upon which to drill wells to provide an adequate water supply from underground sources. Sufficient lands upon which to build, construct, install and operate facilities for the processing, pumping, storage distribution and water management may be acquired by condemnation. (Powell-Florida)
W70-04236

3F. Conservation in Agriculture

ECONOMICS OF GROUNDWATER DEVELOPMENT IN THE HIGH PLAINS OF COLORADO,
Colorado State Univ., Fort Collins. Natural Resources Center.
For primary bibliographic entry see Field 04B.
W70-04049

IMPROVING EFFICIENCY IN AGRICULTURAL WATER USE,
Colorado State Univ., Fort Collins. Natural Resources Center.
W. Doral Kemper, and R. E. Danielson.
Available from the Clearinghouse as PB-189 784, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 5 p, 9 ref. OWRR Project A-002-COLO.

Descriptors: *Water conservation, *Microwatershed, *Irrigation effects, *Moisture stress, *Runoff management, Water management, Evapotranspiration, Crop response, Growth rates, Moisture uptake, Water yield.

Management of runoff under dry land cropping was attempted by collecting precipitation from sealed surfaces 4 ft. to 10 ft. wide on untreated crop strips 18 in. wide. In the dry years of 1966 and 1968, when only six and eight inches of water were avaiable, respectively, (soil storage plus rainfall) yields from microwatersheds were five times yields on untreated check areas. Crops grown included corn, sugar beets, and sweet corn. During the four-year study period, 1967-1969, with an average of 8.5 in. of moisture available, corn on the treated plots yielded 68 bushels per acre compared to 32 bushels per acre from the untreated area. In 1968 when 8 in. of moisture was available, sweet corn on microwatersheds yielded 924 cars per acre compared to 165 cars per acre from the check. Sugar beets yielded 9 tons per acre compared to 3 tons per acre on the check. In 1967 with 11 in. of moisture available, beets on the microwatersheds yielded 12 tons per acre compared to 11 tons per acre on the check. An evaluation of several possible waterproofing or infiltration reducing covers for the microwatersheds were made. Controlling water stress by irrigation scheduling reduced evaporation 61 percent while yields were reduced only 36 percent compared to maximum yields under ideal moisture stress conditions.
W70-04058

SOIL CONSERVATION DISTRICTS.
For primary bibliographic entry see Field 04D.
W70-04221

DRAINAGE AND SOIL CONSERVATION.
For primary bibliographic entry see Field 04D.
W70-04223

MISSOURI WATERSHED PROTECTION AND FLOOD PREVENTION LAW.
For primary bibliographic entry see Field 04D.
W70-04232

AN EVALUATION OF RANGE FLOODWATER SPREADERS,
Geological Survey, Denver, Colo. Water Resources Div.
R. F. Miller, I. S. McQueen, F. A. Branson, L. M. Shown, and Wm. Buller.
Journal of Range Management, Vol 22, No 4, p 246-257, July 1969. 12 p, 14 fig, 1 tab, 22 ref.

Descriptors: *Range management, *Water spreading, *Flood irrigation, Recharge, Erosion, Erosion control, Vegetation effects, Drainage, Water storage, Water yield, Flood control, Hydrographs.
Identifiers: Floodwater spreading.

Range floodwater spreaders are systems of dikes constructed to automatically divert floodflows from gullies and spread them over adjacent range land. The primary purpose of the investigation was to determine what factors influence vegetal response to this supplemental moisture. Forage was established and produced only on sites that received at least one flooding per year. Forage production per unit of water was less when water was ponded and could not drain completely from the soil surface. The total moisture retention capacity of the A and B horizons had more influence than soil texture on the amount of forage produced. (Knapp-USGS)
W70-04324

PASTURE IMPROVEMENT IN THE DESERT ZONES OF UZBEKISTAN,
National Science Foundation, Washington, D.C. Special Foreign Currency Science Information Program.
L. Gaevskaya, Z. Shamsutdinov, and M. Sosnina.
Translation of Uluchsheni E Pastbishch i Sozdanie Senokosov v Pustynnoi Zone Vzbekistana. Available from the Clearinghouse as TT 69-55076. Israel Program for Scientific Translations, Catalog No. 5508; Jerusalem, 1969. 49 p, 26 fig, 4 tab, 38 ref.

Descriptors: *Arid lands, *Pasture management, *Sheep, *Grazing, *Forages, Plant pathology, Browse utilization, Range management, Deserts, Rotations, Seeds, Pest control.
Identifiers: *Uzbekistan, USSR.

Sparse forage vegetation is a major problem in the arid-land sheep pastures of Soviet Central Asia. This situation is often aggravated by either undergrazing or overgrazing the range. In an attempt to relieve the forage problem, measures were introduced utilizing plant pest and disease control, more efficient grazing systems, short- and long-term pasture improvement, and dry-land fodder production. The effects of each of these programs is discussed, but no overall conclusions are drawn. (Carr-Arizona)
W70-04398

SALT AND WATER MOVEMENT INTO SOLONETZIC SOILS,
Department of Agriculture, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 02G.
W70-04400

TRANSPIRATION, EVAPORATION AND DEEP DRAINAGE LOSSES FROM AN ORANGE PLANTATION,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
J. D. Kalma, and G. Stanhill.
Israel Journal of Agricultural Research, Vol 19, No 1, p 11-24, January 1969. 3 fig, 3 tab, 23 ref.

Descriptors: *Semiarid climates, *Evaporation, *Irrigation practices, *Drainage effects, *Evapotranspiration, Irrigation water, Precipitation (Atmospheric), Deep percolation, Orchards, Oranges, Water loss, Sprinkler irrigation, Soil water, Moisture content, Canopy, Throughfall, Water balance, Soil surfaces, Measurement, On-site data collections, Evaporation pans.
Identifiers: *Israel.

A mature orange orchard on the Israeli coastal plain was the site of an intensive one-year study of water loss. Total water income amounted to 569 mm of precipitation and 483 mm of irrigation water. Total water loss consisted of 206 mm of deep drainage and 850 mm of evapotranspiration. Of this latter, 217 mm (26%) was evaporation from the bare soil. It was calculated that if an above-canopy sprinkler system were substituted for the current below-canopy type, total annual water loss would increase by 44 mm. A subsurface irrigation method would decrease water loss by leaving the upper soil layer dry. The estimated reduction of evaporation amounted to 32 mm. (Carr-Arizona)
W70-04402

EFFECTS OF IRRIGATION REGIMES ON GRAPEFRUIT PEEL AND PULP RELATIONSHIPS,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
For primary bibliographic entry see Field 02I.
W70-04403

A WORLD GEOGRAPHY OF IRRIGATION,
Leonard M. Cantor.
Praeger Publishers, New York, Washington, 1970, 252 p, 60 fig, 41 plates, 158 refs, Index.

Descriptors: *Irrigation, *Agriculture, *Arid lands, *Economic impact, *Social aspects, Semiarid climates, Surface waters, Groundwater, Water supply, Irrigation practices, History, United States.
Identifiers: *Geography, Asia, Africa, Latin America, USSR, Europe, Southwest Asia, Australia.

Although irrigated areas of the world have nearly doubled in 20 years, agricultural production has not risen correspondingly. This partly owing to complex social, physical, economic and geographic factors. This book provides the student of geography with a broad picture of irrigated agriculture throughout the world. Although most of the work is concerned with irrigation in arid or semiarid climates, it also reviews supplemental irrigation practices in such areas as monsoon Asia and western Europe. The first section of the volume is devoted to the history of irrigation and its social and economic aspects. The second part reviews the development and current practices of irrigation in each geographic region of the world. (Crouse-Arizona)
W70-04404

EFFECT OF THE PRECEEDING CROP AND AGRONOMIC PRACTICE ON SORGHUM (SORGHUM BICOLOR L. MOENCH) AND GROUNDNUTS (ARACHIS HYPOGAEA L.) IN THE CENTRAL SUDAN,
Agricultural Research Service, Athens (Greece).
P. A. Gerakis, and C. Z. Tsangarakis.
Agronomy Journal, Vol 61, No 5, p 681-683, September-October, 1969. 4 tab.

Descriptors: *Sorghum, *Rotations, *Semi-arid climates, *Fallowing, *Soil moisture, Crop production, Fertilizers, Nitrogen.
Identifiers: *Central Sudan, *Bare fallow, *Groundnuts.

In order to devise an improved rotation policy, an experiment was conducted in the Central Sudan to study effect of previous cultivation on the subsequent sorghum and peanut crop. The use of bare fallow the first year in order to increase soil moisture for the second was also investigated. Except for the top 0.15 meters of soil, soil moisture was significantly higher in bare fallow as compared to weed fallow plots. Moisture increase was not reflected in the yield of either crop. This should not preclude further experimentation with the bare fallow technique, especially in the cultivation of very deep-rooted species. (Carr-Arizona)
W70-04405

ROW SPACING AND FERTILIZATION INFLUENCES ON FORAGE AND SEED YIELDS OF INTERMEDIATE WHEATGRASS, RUSSIAN WILDRYE, AND GREEN NEEDLEGRASS ON DRYLAND,
Agricultural Research Service, Sidney, Mont. Northern Plains Soil and Water Research Center; and Montana Agricultural Experiment Station, Bozeman.
For primary bibliographic entry see Field 02I.
W70-04406

MOISTURE CONTENT OF COTTON LEAVES AND PETIOLES AS RELATED TO ENVIRONMENTAL MOISTURE STRESS,
Texas A and M Univ., College Station; and Texas Agricultural Experiment Station, El Paso.
For primary bibliographic entry see Field 02I.
W70-04407

AGRARIAN STRUCTURE IN THE PIEDMONT OASES OF TARAPACA PROVINCE (IN SPANISH),
Universidad Catolica de Valparaiso (Chile). Departamento de Geografia.
Osvaldo Ossandon.
Revista Geografica de Valparaiso Vol 1, No 1, p 41-62, 1967. 3 fig, 3 tab, 14 ref.

Descriptors: *Land tenure, *Arid lands, *Agriculture, *Social Impact, *Economic Impact, Horticultural crops, Irrigation.
Identifiers: *Tarapaca Province, *Chile, *Oases.

This contribution is part of a regional analysis of Chile's arid Norte Grande which when completed, will give a scientific basis for regional plans and local research in order to utilize to the best possible degree valuable resources or alternate means in areas where lack of resources is an impediment to development. History of land ownership, extent of cultivation, number of ranches and availability of water are discussed at length. One oasis village--Matilla-- is treated in depth, indicating agricultural production, irrigation and problems resulting from continued partioning of land into increasingly smaller parcels. (Moore-Arizona)
W70-04410

SETTLEMENTS NEAR THE ARID MARGIN OF CULTIVATION, NORTHEAST AFRICA (IN GERMAN),
Martin Born.
English Summary. Geographische Zeitschrift, Vol 55, No 4, p 243-278, 1967. 9 maps, 36 refs.

Descriptors: *Arid lands, *Flash floods, *Flood irrigation, *Impoundments, Cotton, Dry farming, Dunes, Forages, Irrigation, Irrigation practices.
Identifiers: *Nomads, *Red Sea Hills, Sudan.

Expansion of cropland in the marginal land adjacent to the very arid portions of East Africa, among the Red Sea Hills, has had a marked effect on the nomads of the area. Cultivation of such areas is dependent on accommodation to a rainfall of less than 200 mm through devices for impoundment of surface water and flood irrigation. The camel-owning tribes of this region are less nomadic than other Sudan tribes, and practice a limited type of agriculture, mostly cotton and forages. As the degree of aridity increases, agricultural development becomes more restricted. Attempts to control flash floods are less than successful, and uncertain rainfall creates a situation unsuited to any more intensive type of farming. Yet the pressures of population, both human and herds, cannot be solved without greater attention to either severely limited numerical control of both, or a more highly sophisticated attack on the technological problems of an exceedingly stressful environment, or both. (Paylore-Arizona)
W70-04411

KHARGA, FROM THE OASIS MAGNA TO THE NEW VALLEY (IN GERMAN),
Heinz Schamp.
Summary in English. Die Erde, Vol 98, No 3, p 173-202, 1967. 1 fig, 54 refs.

Descriptors: *Irrigation, *Deserts, *Water resources development, *Groundwater basins, *Deep-well pumping, Wells, Land resources, Community development, Economic impact, Social aspects, Soil profiles, Arid lands, Water sources, Arable land.
Identifiers: *Oases, *Kharga Oasis, Egypt.

Kharga, one of the largest of the Egyptian oases, was included in the area of the Western Desert selected by Egyptian Government's General Desert Development Organization for land reclamation and resettlement. The first 5-year program (1960-1965) provided approximately 100 deep wells, furnishing irrigation water for the cultivation of some 45,000 feddans (1 feddan = 1.04 acres) as compared with only 6,000 formerly. Although the origin of the groundwater in the Kharga oasis area is not yet identified, current estimates from known supplies indicate that even larger acreage may be brought under cultivation. Topics discussed include groundwater, soils, a history of the oasis detailing recurring desertification, the cost of financing the New Valley project, and settlement problems. The latter topic seeks to compare the old oasis villages with the new settlements, characterized by an influx of new population types: technicians, engineers, and the like. The extreme desertic conditions of the surrounding environment make the Kharga Oasis development one of great general interest, since its success could provide a pilot for similar water-short areas throughout the arid world. The element of its water potential is the critical factor. (Paylore-Arizona)
W70-04412

SOLAR BATTERIES AND AGROECONOMY OF DEVELOPING NATIONS,
Jadavpur Univ., Calcutta (India). Dept. of Electronics and Telecommunication Engineering.
S. Deb, and M. K. Mukherjee.
Indian Journal of Scientific and Industrial Research, Vol 28, No 3, p 81-84, March 1969. 2 tab, 23 ref.

Descriptors: *Irrigation, *Irrigation engineering, *Solar radiation, *Electric power production, *Electric power costs, Irrigation wells, Electric power, Arid lands, Semiarid climates, Agriculture, Economic impact, Energy, Generators, Costs.
Identifiers: *Solar batteries, *Deep-tube wells, India.

Use of solar energy for generating electrical power is of great interest to areas in which there is abundant sunlight but scanty water supply. Irrigation using conventional methods of power generation has some associated difficulties from which solar power would be free. Unfortunately, present solar cells are expensive and incapable of uniform output. The probable details and cost were worked out for a solar battery capable of operating a deep-tube well for irrigation. If present research is able to reduce the cost of solar cells, savings of up to 50% would be possible when compared with conventional power. Considering the importance of irrigation to the economies of developing nations, further research in this field should be encouraged. (Carr-Arizona)
W70-04413

SPRINKLERS AND VEGETABLE CROP MECHANIZATION IN DESERT AREAS,
California Univ., Riverside. Agricultural Extension Service.
Hunter Johnson, Jr., Albert W. Marsh, G. Neil McRae, and Phillip G. Mowbray.
Agricultural Engineering, Vol 51, No 1, p 20-21, January 1970. 1 fig.

Descriptors: *Sprinkler irrigation, *Crop production, *Seeds, *Saline soils, *Vegetable crops, Salt tolerance, Germination, Arid lands, Deserts, Irrigation systems, Furrow irrigation, Temperature, Irrigation efficiency.
Identifiers: *Cabbage, Romaine, Precision planting.

Sprinkler irrigation substantially improves germination and emergence of romaine and cabbage seed. The results are attributed to seed salt zone control. Sprinkler plots were found to have conductivities of from 3 to 4 mmhos in the top inch of soil, compared to 15 to 20 mmhos for furrow-irrigated plots. These findings indicate that precision planting on saline soils could be practical. Sprinklers would be the first step in mechanized culture of vegetable crops, especially in desert areas. (Carr-Arizona)
W70-04415

SPRINKLER FERTILIZATION AND PLANT DAMAGE,
Agricultural Research Service, Kimberly, Idaho. Snake River Research Center; and Idaho Univ., Moscow. Agricultural Experiment Station.
C. L. Douglas, Claude H. Pair, and J. Hamilton Smith.
Agricultural Engineering, Vol 50, No 11, p 687, November 1969. 1 fig.

Descriptors: *Fertilization, *Application methods, *Crop response, *Sprinkler irrigation, *Damages, Crop production, Ammonium compounds, Ureas, Potatoes, Sugar beets, Wheat, Spraying, Fertilizers.
Identifiers: *Plant damage.

Fertilizing plants by sprinkler irrigation is simple and rapid. Unfortunately there is the possibility of high fertilizer concentrations damaging the plant unless fertilizer is rinsed from the leaves. Potatoes, sugar beets, and Lemhi wheat were grown in order to determine safe concentrations of sprinkler - applied fertilizer. Plants were fertilized weekly with ammonium nitrate or ammonium nitrate and urea. Potatoes showed no sign of damage up to 1500 ppm with ammonium nitrate and up to 2000 ppm with nitrate and urea (these were the maximum amounts tested). Sugar beets and wheat also showed no sign of damage up to the limits of the experiment, 2000 ppm of ammonium nitrate. Although these were greenhouse tests, they do indicate that a farmer could sprinkler fertilize at almost any economical rate without damage to his crop. (Carr - Arizona)
W70-04419

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

PHYSICAL, LEGAL AND ECONOMIC ASPECTS OF ASSESSMENT OF COSTS AMONG DRAINAGE DISTRICTS: LEGAL PHASE,
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 06E.
W70-04047

STABILITY OF SLOPES WITH SEEPAGE,
Colorado State Univ., Fort Collins. Natural Resources Center.
For primary bibliographic entry see Field 08D.
W70-04052

DELAWARE RIVER BASIN COMPACT.
For primary bibliographic entry see Field 06B.
W70-04081

FLOOD PLAIN INFORMATION, ARKANSAS RIVER AND TRIBUTARIES, PULASKI COUNTY, ARKANSAS, PART I.
Corps of Engineers, Little Rock, Ark.

Prepared for Pulaski County, Ark. Corps Engineers Flood Plain Report, Nov 1969. 45 p, 16 fig, 27 plate, 12 tab.

Descriptors: *Floods, *Flood damage, *Arkansas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Arkansas River, Pulaski County (Ark), Standard project flood, Intermediate regional flood.

Flooding of the Arkansas River, Pulaski County, Arkansas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-04094

FLOOD PLAIN INFORMATION - COASTAL FLOODING OF VIRGINIA BEACH, VIRGINIA.
Corps of Engineers, Norfolk, Va.

Prepared for the city of Virginia Beach. Corps Engineers Flood Plain Report, July 1969. 59 p, 11 fig, 10 plate, 3 tab.

Descriptors: *Floods, *Flood damage, *Virginia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Virginia Beach (Va), Standard project flood, Intermediate regional flood.

Flooding in Virginia Beach, Virginia is described in a report of flood problems based on records of tides, storms, rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-04095

FLOOD PLAIN INFORMATION, SALADO CREEK, SAN ANTONIO, TEXAS.
Corps of Engineers, Fort Worth, Tex.

Prepared for the San Antonio River Authority. Corps Engineers Flood Plain Report, Oct 1969. 45 p, 6 fig, 28 plate, 13 tab.

Descriptors: *Floods, *Flood damage, *Texas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *San Antonio (Tex), Standard project flood, Intermediate regional flood.

Flooding of Salado Creek, San Antonio, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-04100

WISCONSIN'S FLOOD PLAIN MANAGEMENT PROGRAM.
Wisconsin Dept. of Resource Development, Madison.

Madison: State of Wisconsin, Department of Natural Resources, Nov 1967. 29 p.

Descriptors: *Wisconsin, *Management, *Flood plains, *Regulation, Flood control, Flood protection, Flood forecasting, Flood damage, Flood plain insurance, Flood plain zoning, Floodways, Non-structural alternatives, Floods, Floodproofing.
Identifiers: *Flood plain management.

This flood plain management program consists basically of three parts: (1) evaluation of the flood-

ing potential and identification of the flood plains by using criteria established herein by the Division of Resource Development, (2) formulation, administration and enforcement of reasonable regulations and other flood plain management practices which are based on sound technical data and consistent with state criteria and comprehensive community land use needs, and (3) continuous review and upgrading of flood plain management criteria and regulations based on new hydrologic, hydraulic and other technical information and methods. In addition to a statement of policies and procedures, a number of criteria used to evaluate flood plain regulations. Criteria applying to the following aspects of flood plain regulation were discussed: purposes and objectives, regional flood, flood plain delineation, floodway determination and delineation, regulatory flood protection elevations, floodway encroachments, areas between floodway or encroachment limits and levees, areas landward of floodway or encroachment limits, flood proofing measures, flood protective or control works, modifications or additions to existing structures, removal of designated flood plain limits, certifications of compliance and public information. (Davis-Chicago)
W70-04169

FLOOD-HAZARD MAPPING IN METROPOLITAN CHICAGO,
John R. Sheaffer, Davis W. Ellis, and Andrew H. Spieker.
Available free from the US Geological Survey, Wash, DC, 20242. US Department of the Interior, US Geological Survey, USGS Circular 601-C, 1970. 14 p, 6 fig, 2 tab, 10 ref.

Descriptors: *Cities, *City planning, *Flood plains, *Land use, Storm runoff, Utilities, Urbanization, Flooding, Flood plain insurance, Flood plain zoning, Floodproofing, Floods, Floodways, Flood forecasting, Land management, Land classification, Public lands.
Identifiers: *Chicago, *Flood plain information, *Flood-hazard mapping, *Flood plain management, Crest-stage gaging network.

The effective management of flood plains consists of more than building detention reservoirs and levees. As urban pressures are forcing more and more developments on flood plains, such devices as flood-plain regulations and floodproofing are coming into wider use. These devices require information as to what areas are likely to be flooded. Flood-hazard mapping is such a means of providing flood plain information for planning and management programs. Proper use of flood-hazard mapping will help to: (1) prevent improper land development in flood plain areas; (2) restrict uses that would be hazardous to health and welfare and which would lead to undue claims upon public agencies for remedy; (3) encourage adequate stream channel cross-section maintenance; (4) protect prospective home buyers from locating in flood-prone areas; (5) preserve potential for natural groundwater recharge during flood events; (6) guide the purchase of public open space; and (7) avoid water pollution resulting from the flooding of sewage treatment plants and solid waste disposal sites that were located on flood plains. The implementation of the flood-hazard mapping program in the Chicago area, including the establishment of a crest-stage gaging network is discussed. Examples of the usefulness of flood-hazard maps in urban development are presented, including regulation of private development, purchase of property for public use, development of public facilities and planning guidelines for future development. (Davis-Chicago)
W70-04170

GEORGIA WATER LAW (NAVIGABLE STREAMS, TIDEWATERS),
For primary bibliographic entry see Field 06E.
W70-04204

GEORGIA WATER LAW (DIFFUSED SURFACE WATERS),
For primary bibliographic entry see Field 06E.
W70-04206

GEORGIA WATER LAW (ADMINISTRATIVE STRUCTURE OF WATER USE AND WATER COURSES REGULATION),
For primary bibliographic entry see Field 06E.
W70-04209

WISE USE OF FLOOD PLAINS.

Wise Use of Flood Plains, New England River Basins Comm'n, p 1-34, July 1969. 34 p.

Descriptors: *New England, *Flood protection, *River basin development, *Flood control, Flood plains, Channel improvement, Dams, Flood forecasting, Floodproofing, Levees, Warning systems, Historic flood, Flood plain zoning, Rivers, Streams, Floods, Legislation, State governments, Administration, Federal government, Planning, Permits, Legal aspects.

A general survey is made of the reasons for flood damage to property and the results of previous attempts to lessen this damage. A summary is given of measures presently being employed by state governments to prevent flood damage and soften the effects of injuries which are not preventable. Methods of flood control are divided into preventive and corrective measures. State programs in Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont are described, together with federal programs for flood control. Particular emphasis is placed upon the Report of the Task Force on Federal Flood Control Policy of 1966. The study concludes with recommendations to the federal and state governments of means by which flood losses may be reduced throughout the United States. The recommendations discourage the development of property in areas susceptible to flooding. (See also W70-04214 thru W70-04217). (Dye-Florida)
W70-04213

WISE USE OF FLOOD PLAINS (FLOOD PLAINS).
Wise Use of Flood Plains, New England River Basin Comm'n, p 1-4, July 1969. 4 p.

Descriptors: *New England, *Flood plains, *Flood protection, *Flood damage, Flood control, Legal aspects, Dams, Flood forecasting, Floodproofing, Levees, River basin development, Warning systems, Water management (Applied), Flood plain insurance, Flood plain zoning, Streams, Floods.

Flood damage occurs when areas susceptible to flooding are developed for economic purposes. Though most such areas have had some historical flood problems, severe floods are infrequent and development eventually proceeds despite the danger of flood damage. The increasing urbanization and industrialization of society also contributes to development of areas along the seacoast and larger streams. Thus, despite heavy government expenditures for flood prevention and protection, yearly flood damage rises. The flood plain is a reserve area carved out by a watercourse to hold surplus water in times of flood. A simple solution to flood damage problems is to impede development of flood plains. Needs for railways, highways, hydro-electric plants, and dock facilities make this solution difficult to implement. A diagram shows methods of flood damage prevention, dividing them into corrective and preventive measures. Possible corrective measures include dams and reservoirs, levees, channel improvements, evacuation forecasting, and urban redevelopment. Preventive measures include zoning, building codes, development policies, warning signs, and insurance. (See W70-04213). (Dye-Florida)
W70-04214

WISE USE OF FLOOD PLAINS (STATE FLOOD CONTROL REGULATION).
Wise Use of Flood Plains, New England River Basin Comm'n, p 5-14, July 1969. 10 p.

Descriptors: *New England, *Flood plain zoning, *Flood control, *Flood protection, Legislation, Legal aspects, River basin development, Water management (Applied), Water policy, Flood plains, Rivers, Streams, Floods, State governments, Administration, Planning, Permits, Administrative agencies.

Following extremely severe flood damage in 1955, Connecticut enacted the Stream Encroachment Law which empowers a Water Resources Commission to establish enroachment lines along waterways and flood-prone areas. Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont have passed zoning enabling acts, allowing municipalities to zone flood plains for low-damage uses. Maine's executive agencies must consider potential flood damage in planning state-supported land development. Massachusetts has empowered the Department of Natural Resources to restrict urban development in areas of high flood danger; however, when a landowner objects to these restrictions on the development of his land, the Department must withdraw the restrictions or purchase the land. New Hampshire, New York, and Vermont are considering plans for flood control. Rhode Island has enacted zoning regulations which take into account the susceptibility of land to flooding. (See W70-04213). (Dye-Florida)
W70-04215

WISE USE OF FLOOD PLAINS (FEDERAL FLOOD CONTROL POLICY).
Wise Use of Flood Plains, New England River Basin Comm'n, p 14-29, July 1969. 16 p.

Descriptors: *Federal government, *Flood plains, *Flood control, *Administration, Administrative agencies, Project planning, Flood protection, Flood damage, Flood forecasting, Flood proofing, River basin development, Warning systems, Flood plain zoning, Floods, Legal aspects.

The Task Force on Federal Flood Control Policy was appointed to report on the causes of flood damage and applicable solutions. The Task Force recommended that the federal government undertake the following: (1) improvement of the knowledge of flood hazards, (2) coordination of plans for development of flood plains, (3) initiation of a program of technical information made available to flood plain managers, (4) creation of a national flood insurance plan, and (5) continued adjustment of federal flood control policy to changing needs. The Task Force made additional proposals for implementation of these major programs. The Corps of Engineers and the Soil Conservation Service should collect data on flood plains. Federally sponsored housing and assistance programs should consider the flood factor in their administration. An improved system for flood forecasting and warning should be devised. Land acquisition by government should become part of flood control policy. Federal assistance programs should be utilized to soften the effects of flood damage. (Dye-Florida)
W70-04216

WISE USE OF FLOOD PLAINS (RECOMMENDATIONS FOR WISE FLOOD PLAIN MANAGEMENT).
Wise Use of Flood Plains, New England River Basins Comm'n, p 30-34, July 1969. 5 p.

Descriptors: *Flood plains, *Administration, *Flood protection, *Flood plain zoning, Flood control, Federal government, State governments, Administrative agencies, Project planning, Flood damage, Flood forecasting, River basin development, Warning systems, Legal aspects, Cities.

Under existing laws in New England, towns and cities have the best opportunity to make wise use of

flood plains. State governments and the federal government can give some support. Each community should have a zoning code which implements its flood control policy. Each community, with the aid of federal agencies, should map areas subject to frequent flooding. Communities may condemn and purchase flood-prone lands, and federal grants may be available to aid in these purchases. Federal participation in flood plain management is limited to technical assistance to the state or local government. Each state should have a single office administering flood plain management. Executive orders should be issued to deter unwise flood plain development. State and local tax policies should encourage the continuance of present open or wetland areas. Flood forecasting and data collection should be emphasized. (Dye-Florida)
W70-04217

DRAINAGE DISTRICTS (GENERAL PROVISIONS).
Mo Ann Stat secs 242.010 thru 242.050 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Drainage districts, *Drainage engineering, *Drainage programs, Legal aspects, Drainage systems, Administration, Legislation, Swamps, Wetlands, Land reclamation, Environmental sanitation, Sanitary engineering, Public health, Public benefits, Environmental engineering, Projects, Project planning, Programs, Agricultural engineering, Conservation.

The owners of a majority of the acreage in any contiguous body of swamp, wet or overflowed lands, or lands subject to overflow may form a drainage district to reclaim and protect the lands and other property from the effects of water, for sanitary or agricultural purposes, or for public convenience, health, welfare or benefit. The procedures in forming and organizing the drainage district are prescribed. The procedure for objecting to the formation of a drainage district by an owner of real estate or other property is set forth. The annexation of land to organize the drainage district is regulated. (Powell-Florida)
W70-04219

COOPERATION BY CITIES OF 100,000 INHABITANTS AND MORE WITH DRAINAGE DISTRICTS, ETC., FOR FLOOD PROTECTION.
For primary bibliographic entry see Field 03D.
W70-04230

NICHOLSON V HOLLOWAY PLANTING COMPANY (SERVITUDE OF DRAIN).
229 So 2d 679-697 (La 1969).

Descriptors: *Louisiana, *Water rights, *Drainage water, *Surface runoff, Judicial decisions, Legal aspects, Drainage practices, Surface waters, Water management (Applied), Easements, Preferences (Water rights), Riparian rights, Adjudication procedure, Overlying proprietor, Relative rights, Natural flow doctrine, Reasonable use, Obstruction to flow, Alteration of flow, Riparian land, Flow control, Watercourses (Legal).

Plaintiff's estate was adjacent to and north of defendant's estate. Both plantations fronted on the west side of a bayou. The predominant slope was from east to west from the bayou. Running across both properties are the remnants of numerous old crevasse channels, formed by the flood waters of the bayou. Plaintiff sought recognition of a servitude of drain in favor of his estate over defendant's adjoining property. The court held that plaintiff's estate was dominate; that channels naturally drained water from plaintiff's estate across defendant's estate; and that plaintiff's estate had a servitude of drain over defendant's estate. A controlling Louisiana Civil Code stated that lower land was legally obligated to receive surface waters which flow naturally through channels of natural origin from the adjoining dominant estate. But this included only such as would ordinarily run there in view of the land's configuration. The court also determined that a proprietor of an upper estate could make works tending to accelerate and hasten drainage of his own land beyond the natural slow process, but he could do nothing which would tend to throw upon the lower estate the burden of receiving waters which would not otherwise drain upon it. (Powell-Florida)
W70-04234

DRAINAGE DISTRICTS.
Mo Ann Stat secs 242.190, 242.210 (Legis Service No 1 1969).

Descriptors: *Missouri, *Drainage districts, *Administrative agencies, *Drainage, Legislation, Reclamation, Channel improvement, Reservoirs, Condemnation, Easements, Right-of-way, Bridges, Structures, Ditches, Levees, Land reclamation, Hydroelectric power, Hydroelectric plants, Construction, Maintenance, Electric power, Dams, Taxes, Assessments, Damages, Alteration of flow.

In order to effect the drainage, protection, and reclamation of property within the drainage district, the board of supervisors is authorized to: (1) clean out, straighten, widen, deepen, or change the course of flow of any ditch, drain, river, or watercourse; (2) fill up any creek, drain, channel, river, or watercourse; (3) concentrate, divert, or divide the flow of water in or out of the district; (4) construct and maintain ditches, canals, levees, dikes, dams, reservoirs, pumping stations and other needed improvements; and (5) construct all needed bridges, works, and improvements. The board is authorized to acquire and hold property and may condemn any needed land, easement, or right of way, reservoir, or holding basin. The board is empowered to control all water power created by the construction of works of the district and may construct and maintain hydroelectric power plants to develop such power. Any surplus power in excess of that required by the district may be leased. (Schram-Florida)
W70-04238

DRAINAGE DISTRICTS (BOARD OF SUPERVISORS).
Mo Ann Stat secs 242.060 thru 242.210 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Administration, *Drainage districts, *Drainage engineering, Legislation, Drains, Drainage systems, Drainage programs, Legal aspects, Administrative agencies, Regulation, Hydroelectric plants, Water works, Condemnation, Construction, Maintenance, Water control, Operation and maintenance, Project planning, Electric power production.

The board of supervisors for a drainage district is authorized and empowered to clean out, widen, alter, or deepen any ditch, drain, lake, or watercourse in the district. The board is authorized to fill any creek, drain, channel or watercourse; concentrate, divert, or divide the flow of water in or out of the district; and construct and maintain main and lateral ditches, canals, levees, dikes, dams, sluices, revetments, reservoirs, holding basins, floodways, pumping stations, syphons, and any other improvements deemed necessary to preserve and maintain works inside or outside of the district. The board is empowered to construct or enlarge necessary bridges. The board may purchase or condemn any land, easement, railroad right-of-way, sluice, reservoir, holding basin, or franchise in carrying out its function. The board of supervisors may control all water power created by the construction of works in the district, and has the authority to construct and maintain hydroelectric power plants. (Powell-Florida)
W70-04242

DRAINAGE DISTRICTS (ORGANIZATION).
Mo Ann Stat secs 242.220 thru 242.300 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Land reclamation, *Drainage districts, *Drainage engineering, Administration, Regulation, Legislation, Legal aspects, Levees, Drainage, Surface drainage, Drainage programs, Land management, Assessments, Projects, Project planning, Benefit sharing, Appraisals, Administrative agencies, Cost sharing, Cost-benefit theory, Damages.

The chief engineer of each drainage district is required to survey all lands within the district and all other lands which may be affected by improvements constructed in the district. The chief engineer's annual report is to be used as a basis for draining, leveeing, or reclaiming lands of the drainage district or preserving them from injury by overflow water. The circuit court may appoint commissioners to appraise lands to be acquired by the district for rights of way, holding basins, and other drainage works, and to assess benefits and damages accruing to district lands and other property by reason of planned land reclamation. The drainage district or any landowner in the district may file exceptions to the commissioners' report or to any assessment for either benefits or damages. (Powell-Florida)
W70-04245

DRAINAGE DISTRICTS (RECLAMATION).
Mo Ann Stat secs 242.310 thru 242.360 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Drainage districts, *Administrative agencies, *Land reclamation, Drainage systems, Drainage programs, Drainage engineering, Compensation, Damages, Eminent domain, Contracts, Ditches, Levees, Canals, Government finance, Assessments, Construction, Bridge construction, Bridges, Highways, Excavation, Laterals, Embankments, Legislation, Legal aspects.
Identifiers: *Liens.

The board of supervisors of any drainage district may petition the circuit court to change the plan for reclamation of district lands, subject to challenge by the affected landowners. The court may appoint three commissioners to assess the damages and compensation to be paid to such landowners. The board is authorized to construct or contract for the construction of any works necessary to carry out the plan for reclamation. A chief engineer shall supervise all works and improvements. Enlargement of ditches or other improvements may be authorized by the board to remedy any inadequacies in the reclamation plan. Plans for all bridges to be constructed or enlarged under the plan must be approved by the chief engineer. Corporations may be required to construct or enlarge their own bridges. Landowners may construct bridges over any drainage structure. All drainage districts may install ditches across any highway provided the district builds a bridge across the ditch. (Dearing-Florida)
W70-04246

A CASE FOR THE SIMULTANEOUS APPLICATION OF DETERMINISTIC AND STOCHASTIC METHODS IN HYDROLOGY,
Manchester Coll. of Science and Technology (England).
J. B. White.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 74, p 595-599, 1967. 5 p.

Descriptors: *Streamflow forecasting, *Flood forecasting, *Statistical models, Stochastic processes, Discharge (Water), Unit hydrographs, Probability, Rainfall-runoff relationships, Runoff forecasting.
Identifiers: Watershed models.

The significance of deterministic models and stochastic variables (in the sense in which the terms are used in this paper) are outlined. Possible ways of combining stochastic and deterministic analyses are given for the ideal circumstances in which

deterministic knowledge would be completely accurate. It is then shown with the aid of illustrations concerning the extension of streamflow totals and the prediction of flood discharges that when deterministic knowledge is incomplete, the application of deterministic methods and of stochastic analysis in separate stages is inadequate. Instead the whole analysis must have a stochastic framework. (Knapp-USGS)
W70-04259

DRAINAGE DISTRICTS (CONNECTING SYSTEMS AND TAXATION).

Mo Ann Stat secs 242.370 thru 242.490 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Drainage districts, *Drainage systems, *Taxes, Assessments, Government finance, Costs, Ditches, Drainage engineering, Drainage programs, Drains, Administrative agencies, Levees, Dikes, Compensation, Surveys, Land reclamation, Principal, Interest, Construction costs, Operation and maintenance, Legislation.
Identifiers: *Bonds.

All drainage systems already constructed in a newly organized drainage district may be connected and made part of the drainage plan of that district. Systems constructed after completion of the drainage plan may be connected with the district's drainage system only with the approval of the board of supervisors of the drainage district or upon petition in the circuit court. District overseers shall repair and maintain the drainage system within the district. The board may levy land taxes following a specified procedure to finance the organization, construction, and maintenance of the district. Taxes shall be levied in proportion to the benefits accruing to the lands. The board may issue bonds on the tax levies to be paid out of these taxes. (Dearing-Florida)
W70-04286

AN EVALUATION OF RANGE FLOODWATER SPREADERS,
Geological Survey, Denver, Colo. Water Resources Div.
For primary bibliographic entry see Field 03F.
W70-04324

SURFACE WATER RESOURCES OF SOUTH AFRICA,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-04334

DELAWARE RIVER BASIN COMPACT (WATER SUPPLY, POLLUTION CONTROL, FLOOD PROTECTION).
For primary bibliographic entry see Field 06B.
W70-04359

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN ARIZONA.
Corps of Engineers, San Francisco, Calif. South Pacific Div.

U. S. Army Corps of Engineers, South Pacific Division, San Francisco, California, January 1969. 50 p, map.

Descriptors: *Planning, *Arizona, *Water resources development, *Flood control, Channel improvement, Multiple-purpose reservoirs, *Colorado River basin, Dams, Flood Plains, Recreation facilities, Semiarid climates, Arid lands.
Identifiers: *Gila River, Flood plain management, U.S. Army Corps of Engineers.

This publication contains current information on the Arizona water resources development program of the U.S. Army Corps of Engineers. The Corps' role in flood control and multiple-purpose reservoir projects is briefly outlined. Information is included on completed projects, as well as on projects in the investigation, planning, or construction stages. (Carr-Arizona)
W70-04387

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN CALIFORNIA.
Corps of Engineers, San Francisco, Calif. South Pacific Div.

U.S. Army Corps of Engineers, South Pacific Division, San Francisco, California, January 1969. 276 p, maps.

Descriptors: *Planning, *California, *Coastal engineering, *Multiple-purpose reservoirs, *Flood control, Navigation, Harbors, Shore protection, *Water resources development, Erosion control, Flood plains, Beach erosion, Recreation facilities, Semiarid climates.
Identifiers: *Debris control, Flood plain management, *U.S. Army Corps of Engineers.

This publication contains current information on the California water resources development program of the U.S. Army Corps of Engineers. The Corps' role in projects concerning beach erosion control, debris control, navigation, multiple purpose reservoirs, and flood control is briefly outlined. Information is included on completed projects, as well as on projects in the investigation, planning, or construction stages. Water resources development in arid and semiarid areas of California, as well as coastal areas, are discussed. (Carr-Arizona)
W70-04388

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN UTAH.
Corps of Engineers, San Francisco, Calif. South Pacific Div.

U.S. Army Corps of Engineers, South Pacific Division, San Francisco, California, January 1969. 32 p, maps.

Descriptors: *Planning, *Utah, *Flood control, *Multiple-purpose reservors, *Water resources development, Flood plains, Semiarid climates.
Identifiers: *Flood plain management, *U.S. Army Corps of Engineers.

This publication contains current information on the Utah water resources development program of the U.S. Army Corps of Engineers. The Corps' role in flood control, and multiple purpose reservoir projects is briefly outlined. Information is included on completed projects, as well as on projects in the investigation, planning, or construction stages. (Carr-Arizona)
W70-04393

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN NEVADA.
Corps of Engineers, San Francisco, Calif. South Pacific Div.

U.S. Army Corps of Engineers, South Pacific Division, San Francisco, California, January 1969. 38 p, maps.

Descriptors: *Planning, *Water resources development, *Nevada, *Flood control, *Colorado River basin, Multiple-purpose reservoirs, Semiarid climates, Flood plains, Recreation facilities.
Identifiers: *U.S. Army Corps of Engineers, Flood plain management.

This publication contains current information on the Nevada water resources development program of the U.S. Army Corps of Engineers. The Corps' role in flood control and multiple-purpose reservoir projects is briefly outlined. Information is included on completed projects, as well as on projects in the investigation, planning, or construction stages. (Carr-Arizona)
W70-04394

THE SEWERAGE AND DRAINAGE PROBLEM,
Department of Public Works, Chicago, Ill.
A. L. Tholin.
In: Environmental Engineering and Metropolitan Planning, edited by John A. Logan, Paul Opperman, and Norman E. Tucker, Evanston, Illinois: Northwestern University Press, 1963, p 91-109.

Descriptors: *Sewerage, *Drainage, *Urbanization, Conduits, Construction costs, Financing, Detention reservoirs, Gaging stations, Floodway, Floodproofing, Flood damage, Planning, Water pollution, Drainage systems, Public health, Sewage treatment.
Identifiers: *Combined sewers, *Sanitary sewers, *Storm sewers, Master plan, Sewer design, Metropolitan Sanitary District of Greater Chicago, Northeastern Illinois Planning Commission.

Recommendations are made regarding the sewerage and drainage problem. The desirable solution of the sewerage and drainage problem should include the following action: (1) convey spent water quickly by underground conduits to the place of treatment and disposal; (2) avoid combined sewers, if possible. Take a look at what they spill, and where; (3) design so as to conserve and utilize energy of flow to achieve economy of construction cost. There are many competing uses for public funds; (4) detain stormwater near the origin, where possible; next, in the neighborhood, or finally, in the valleys--but for the good of our pocketbooks and our downstream neighbors, hold all we can, as long as we can; (5) interpret river gagings with a critical eye. Estimate the effect of urbanization; (6) find out what flow-ways we need, establish and maintain them. If we can't afford to clear them all at once, try flood-proofing, and brace ourselves against damage; and (7) have a master plan. Included in the paper are: a formal comment, a discussion and a workshop regarding the subject matter. (Richard-Chicago)
W70-04431

A STORM DRAINAGE AND OPEN SPACE MASTER PLAN FOR HAMILTON COUNTY, OHIO,
Ralph G. Berk.
Hamilton County, Ohio Regional Planning Commission, Dec 1966. 77 p, 13 fig, 2 plate. HUD Urban Planning Project Ohio P-53.

Descriptors: *Drainage systems, Storm runoff, Sewers, Urbanization, Surface runoff, Floodproofing.
Identifiers: *Hamilton County, Ohio.

A planning study of Hamilton County, Ohio which provides a complete inventory and location of all streams, culverts, and bridges having drainage areas greater than 300 acres. Given are the complete physical characteristics of the drainage structures and the intervening reaches of their streams; a method is developed for determining flood flows. Flow quantities to be considered for design purposes are established, as well as indications for improvement of inadequate flows. The study provides accurate information about present and future flood hazards, their location and extent; about the erosion and siltation problems; and about open space needs. Provided are suggestions for subdivision regulations for the enabling and enforcing of protective measures. Supplied are guidelines for legislation necessary for carrying out any plans selected by decision makers. Suggestions for the financing and administering of public improvement programs are also made. (Starr-Chicago)
W70-04434

LEVEE DISTRICTS.

Ark Stat Ann secs 21-601 thru 21-653 (1968).

Descriptors: *Arkansas, *Levees, *Flood control, *Water districts, Legislation, Legal aspects, Engineering structures, Flood protection, Projects, Project planning, Civil engineering, Assessments, Land management, Administrative agencies, Administration.
Identifiers: *Levee districts.

Levee districts are created by the county court of the county containing lands subject to overflow. Consolidation of levee district boards is permitted with consent of the county courts involved whenever land in two or more counties is subject to overflow from the same crevasses or direction. Levee district boards may cooperate with any levee board of another state if necessary to complete their system of levees. Procedures for formation of the levee district and election of the directors of the levee board are enumerated. The board of directors has exclusive control and supervision of the levees in their district. The levee board determines what work must be done, what levees are to be constructed and protects the district from overflow. Procedures for assessment of lands subject to overflow and benefitted by the necessary work are enumerated. (Powell-Florida)
W70-04457

BIOLOGY OF THE CRAYFISH ORCONECTES CAUSEYI AND ITS USE FOR CONTROL OF AQUATIC WEEDS IN TROUT LAKES,
Bureau of Sport Fisheries and Wildlife, Washington, D.C.
For primary bibliographic entry see Field 02H.
W70-04500

4B. Groundwater Management

ECONOMICS OF GROUNDWATER DEVELOPMENT IN THE HIGH PLAINS OF COLORADO,
Colorado State Univ., Fort Collins. Natural Resources Center.
D. D. Rohdy.
Available from the Clearinghouse as PB-189 781, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Completion Report, June 30, 1969. 7 p. OWRR Project B-007-COLO.

Descriptors: *Groundwater, *Development, *Linear programming, *Economic life, *Secondary effects, *Institutional structure, Farm adjustments, Aquifer, Water management, Legal problems.

Farmers using pump irrigation on the High Plains can make good returns from irrigating crops if they include sugar beets in the crop pattern and obtain high yields on all crops. High quality management is essential because average crop yields, or crop patterns without sugar beets, result in substantially lower net returns to management and labor. Irrigated agriculture on the High Plains can remain profitable for a minimum of approximately 40 years to a maximum of about 200 years depending on how fast the water is pumped from the underground aquifer. However, it should be pointed out that these estimates are based on current cost and return relationships. The secondary effects of groundwater development are the greatest on local agricultural trade and service sectors. The magnitude of these effects was estimated with an input-output study in one county on the High Plains. The income distribution effects of existing and alternative institutional arrangements for rationing water among competing users are examined for possible clues to reducing conflicts arising from the development and use of groundwater.
W70-04049

UNDERGROUND STORAGE OF IMPORTED WATER IN THE SAN GORGONIO PASS AREA, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
R. M. Bloyd, Jr.
Geological Survey Open-file report, July 30, 1969. 41 p, 10 fig, 7 tab, 21 ref.

Descriptors: *Water storage, *Artificial recharge, *California, Water yield, Discharge (Water), Interbasin transfers, Water resources development, Water management (Applied).
Identifiers: San Gorgonio Pass (Calif).

Estimated long-term average annual precipitation in the San Gorgonio Pass Water Agency drainage area is 332,000 acre-feet, and estimated average annual recoverable water is 24,000 acre-ft, or less than 10% of the total precipitation. Estimated average annual surface outflow is 1,700 acre-ft, and estimated average annual groundwater recharge is 22,000 acre-ft. Estimated subsurface outflow from the area in 1967 was 6,000 acre-ft into the Redlands area, 220 acre-ft into Potrero Canyon, and 800 acre-ft into the fault systems south of the Banning storage unit. An anticipated 17,000 acre-ft of water per year will be imported by 1980. Information developed in this study indicates it is technically feasible to store imported water in the eastern part of the Beaumont storage unit without causing adverse conditions and without losing any significant quantity of stored water. (Knapp-USGS)
W70-04102

ARTIFICIAL RECHARGE AND ITS POTENTIAL IN ILLINOIS,
Illinois State Water Survey, Urbana. Hydrology Section.
H. F. Smith.
Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 136-142, 1967. 7 p, 1 fig, 3 tab.

Descriptors: *Artificial recharge, *Water spreading, *Filtration, *Infiltration, *Illinois, Sands, Aquifers, Gravels, Pit recharge, Porous media, Filters, Turbidity, Temperature, Water quality.
Identifiers: Peoria (Ill).

A definite relationship is shown between the grain size of filter blankets and the amounts of sediment that penetrate the aquifer through recharge pits. High rates of recharge have been achieved under certain conditions where the filter grain size was optimum, the pit the correct shape, and the permeability high. Criteria established for evaluating the recharge potential of aquifers include thickness of aquifer, areal extent of aquifer, and minimum economical withdrawal rate, as well as limits of turbidity, temperature, and mineral and bacteriological quality of recharge water. These recharge criteria were applied to areas of Illinois where aquifers were known to exist. Estimates were made of the potential artificial recharge into surface sands and gravels of the state, particularly in northeastern Illinois where population is dense and where withdrawal exceeds natural and induced recharge. (Knapp-USGS)
W70-04119

ARTIFICIAL CONTROL OF STATIC FISSURE-KARST WATER RESOURCES IN CARBONATE ROCKS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
N. I. Plotnikov.
Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 132-135, 1967. 4 p, 1 tab.

Descriptors: *Water storage, *Aquifers, *Artificial recharge, *Conjunctive use, *Limestones, Infiltration, Groundwater movement, Water yield, Induced infiltration, Surface-groundwater relationships, Permeability, Pumping, Runoff, Arid lands.
Identifiers: USSR.

Carbonate rocks are characterized by high recharge rates. Given the rock thickness required and an intermittent source of runoff, artificial recharge and static storage control of groundwater are feasible using dual-purpose water-supply wells. Water supply wells are constructed in contour well systems in river valleys at depths of 150 to 200 meters. Under the effect of the intensive groundwater pumping large cones of depression are formed around the water intakes. Favorable conditions are thus created for intensive recharge by floodwater and for the complete return of the static storage previously used. Operation practice of water-supply wells in the USSR in arid regions use constant well yields up to 100,000-150,000 cu m/day. (Knapp-USGS)
W70-04120

THE STORAGE CAPACITY IN THE DUNE-WATER CATCHMENT AREA OF AMSTERDAM AND ITS EFFECT ON THE WATER QUALITY,
Municipal Waterworks of Amsterdam (Netherlands).
For primary bibliographic entry see Field 03B.
W70-04121

ARTIFICIAL RECHARGE OF WATER THROUGH WELLS: EXPERIENCE AND TECHNIQUES,
R. Sternau.
Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 91-100, 1967. 10 p, 10 fig.

Descriptors: *Artificial recharge, *Aquifers, *Limestones, *Injection wells, Hydrogeology, Water wells, Recharge wells, Groundwater management (Applied), Conjunctive use, Arid lands, Costs, Model studies.
Identifiers: *Israel, Well construction.

During recent years recharge operations were carried out in Israel in more than 100 wells. The amount of injected water totaled over 100 million cu m. In the wells of the limestone-dolomite aquifer the recharge rates reached over 2.000 cu m per hr and more during prolonged uninterrupted periods. The performance of the recharge wells are very satisfactory. Experience shows that it is unsuitable to recharge a well with free-falling water because air was sucked into wells during the process. When the inflow of water was stopped, air was released and burst out powerfully from the well casing, gathering water on its way. Where the limestone aquifer was directly overlain by layers of loose sand, the injected water rose up into the sand, and then dropped upon stoppage of injection, and subsidence of the ground occurred which caused complete loss of one well. Recommendations are made for adequate injection procedures and well construction. The choice of type of installation depends on the required hydrological benefits, and on type of operation (depending on whether a pause between injection and pumping is desired). The various techniques are compared and a proposal is made for a standardized installation to be used in wells for both pumping and recharging. (Knapp-USGS)
W70-04122

ARTIFICIAL RECHARGE THROUGH AUGMENTED BANK STORAGE,
Princeton Univ., N.J. Dept. of Civil and Geological Engineering.
R. J. M. De Wiest.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (Mar 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 53-68, 1967. 16 p, 6 fig, 10 ref.

Descriptors: *Artificial recharge, *Alluvium, *Groundwater basins, *New Jersey, Bank storage, Dams, Reservoirs, Floods, Streamflow, Surface-groundwater relationships, Unsteady flow.

Identifiers: Princeton (NJ).

Nonsteady flow is examined for groundwater recharge project in which rainfall runoff is returned to a watertable aquifer in the vicinity of Princeton, N.J. The recharge is accomplished by damming a river and its tributary and by reversing the hydraulic gradient between the river and its connected groundwater basin. Most of the natural recharge occurs during the rainy season from November to late May. With the resulting buildup of the groundwater level, effluent discharge to the rivers increases. This increase ultimately is a net loss of fresh water to the ocean. This loss would be reduced significantly by the construction of dams. The increased water level in the rivers would automatically decrease the hydraulic gradient from the groundwater reservoir to the rivers and hence limit the effluent discharge. Simultaneously, the groundwater reservoir would be pumped and this would make available more storage space. (Knapp-USGS)
W70-04125

GEOLOGIC AND HYDROLOGIC FACTORS RELATED TO ARTIFICIAL RECHARGE OF THE CARBONATE-ROCK AQUIFER SYSTEM OF CENTRAL ISRAEL,
Geological Survey, Washington, D.C.
Robert Schneider.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (Mar 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 37-45, 1967. 9 p, 4 fig, 12 ref.

Descriptors: *Artificial recharge, *Injection wells, *Aquifers, Groundwater movement, Limestones, Water levels, Surveys, Hydrogeology, Data collections, Aquifer characteristics, Geologic control, Stratigraphy, Structural geology.
Identifiers: *Israel.

In central Israel one of the main sources of groundwater is a thick, highly permeable dolomite and limestone aquifer system known as the Cenomanian-Turonian aquifer. Its porosity is mainly solution channels and cavities produced by faulting and folding. Owing to the scarcity of suitable surface reservoir sites, excess water is injected into the aquifer for storage during the non-irrigation season. One of the most important considerations in planning artificial recharge is the selection of injection areas that are hydraulically remote from discharge areas. The piezometric surface is very flat but under natural conditions flow is generally westward and northwestward. Intensive pumping from about 1950 to the present has produced several irregularly shaped shallow depressions. There are also several northeast trending 'hills' or 'ridges' on the piezometric surface. The ridges appear to coincide with downfaulted blocks or structural basins, regarded as regions of relatively lower permeability than adjacent regions of lower piezometric levels. As the piezometric depressions remote from the discharge areas are deepened by pumping, they will become increasingly useful as storage areas for injected water. An ideal condition for an injection area is a well-defined piezometric depression with one or more piezometric 'ridges' between it and the discharge area. (Knapp-USGS)
W70-04126

THE SPREADING PATTERN OF INJECTED WATER IN A PERMEABILITY STRATIFIED AQUIFER,
Water Planning for Israel Ltd., Tel Aviv.
A. Mercado.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (Mar 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 23-36, 1967. 14 p, 6 fig, 1 tab, 13 ref.

Descriptors: *Artificial recharge, *Dispersion, *Aquifers, *Anisotropy, Diffusion, Groundwater movement, Permeability, Transmissivity, Porosity, Stratification, Surveys, Model studies, Water yield, Discharge (Water), Recharge, On-site tests, Injection wells.
Identifiers: *Israel.

An explanation is given of the existence of a transition zone between injected water and aquifer water, developed on the assumption of flow through a permeability horizontally stratified aquifer, in which the frequency of permeabilities follows approximately the normal distribution function. The resulting transition zone is 'S'-shaped, and similar to that caused by dispersion. Its shape depends on the permeability distribution factor. The width of the transition zone caused by the horizontally stratified flow is directly proportional to the distance travelled, while the width of the transition zone caused by dispersion is proportional to the square root of the distance travelled. The width of the dispersion transition zone increases during the return flow, whereas width decreases in the case of horizontally stratified return flow. It is believed that in nature the flows occur simultaneously and thus the shape and width of the transition zone is the resultant of the two processes. A field experiment of the 'injection-pumping pair' type carried out at the Haifa Bay Experimental Field is described and interpreted. The results of the investigations in the experimental field are applicable to large-scale underground recharge and mixing operations. (Knapp-USGS)
W70-04127

ELECTROMODELLING AS AN EFFECTIVE METHOD OF PROGNOSTICATING RESOURCES OF UNDERGROUND WATER DURING THEIR REPLENISHMENT,
For primary bibliographic entry see Field 07C.
W70-04128

GEORGIA WATER LAW (SUBTERRANEAN WATERS, PERCOLATING WATERS SUBTERRANEAN STREAMS, SPRINGS),
For primary bibliographic entry see Field 06E.
W70-04207

MOJAVE RIVER BASIN GROUNDWATER RECHARGE WITH PARTICULAR REFERENCE TO THE CALIFORNIA FLOODS OF JANUARY AND FEBRUARY 1969,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02F.
W70-04323

EXPLOITATION TEST ON THE SUB-ALLUVIAL AND SUB-FLUVIAL MEUSE GROUNDWATER TO THE NORTH OF VERDUN (IN FRENCH),
J. Forkasiewicz, and M. Guillaume.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 143-158, 1967. 16 p, 9 fig, 2 tab.

Descriptors: *Water storage, *Artificial recharge, *Karst, *Limestones, Surface-groundwater relationships, Groundwater movement, Transmissivity, Permeability, Induced infiltration, Water levels, Water-level fluctuations.
Identifiers: *France, Verdun, Lorraine.

To provide for increasing water needs of France's North and Lorraine industrial areas, a plan is proposed to use Jurassic karstic limestones near Verdun for water storage. Winter high streamflow will be stored by recharge wells to supply summer withdrawal of 100,000 cu m/day without decreasing riverflow of alluvial water supplies. Pumping rates will be controlled by use of data from a network of monitor wells. Results of 5 years of field study including a 200-day pumping test are tabulated and shown graphically. (Knapp-USGS)
W70-04351

ARTIFICIAL RECHARGE BY INDUCED INTERAQUIFER LEAKAGE,
Geological Survey, Columbus, Ohio.
Morris Deutsch.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 159-172, 1967. 14 p, 11 fig, 1 photo, 2 tab, 5 ref.

Descriptors: *Artificial recharge, *Induced infiltration, *Michigan, *Aquifers, Glacial drift, Aquicludes, Recharge wells, Leakage, Sands, Gravels, Surface-groundwater relationships, Water spreading, Water storage.
Identifiers: *Kalamazoo (Mich), *Induced aquifer leakage.

The U. S. Geological Survey and the city of Kalamazoo, Michigan, conducted tests to demonstrate the feasibility of recharging an artesian glacial-drift aquifer by inducing leakage to it from a surficial sand aquifer. The surficial sand is under water-table conditions and in direct hydraulic connection with a creek draining it. Coefficients of leakage for the aquiclude ranged from 0.042 to 1.3 gpd/ sq ft/ft. The piezometric surface in the lower aquifer was higher than the water table in the upper sand, and leakage through the aquiclude was upward. Withdrawal of water from the lower aquifer reversed the direction of leakage, but sustained pumping would have resulted in objectionable declines in the piezometric surface and probable inflow of poor-quality water from below. Tests were run by pumping from the lower aquifer under different conditions of artificial recharge of the upper aquifer. Each test resulted in increased head differences between the upper and lower aquifers, which increased the rate of leakage and raised water levels in the lower aquifer. The rates of leakage were 1,600-1,900 gpm, respectively. After 6 years of pumping at the well field with artificial recharge, water levels have not declined appreciably. (Knapp-USGS)
W70-04352

RECHARGE AND WATER INJECTION IN UNDERGROUND AQUIFERS (IN FRENCH),
J. Tixeront, and J. M. Daniel.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 173-181, 1967. 9 p, 1 fig, 7 ref.

Descriptors: *Artificial recharge, *Water spreading, *Induced infiltration, *Permeability, *Infiltration, Groundwater movement, Arid lands, Sands, Silts, Clays, Water quality, Turbidity, Analog models, Resistance networks, Optimization, Discharge (Water), Water yield.
Identifiers: France, Clogging.

Thorough analysis of natural recharge conditions is essential to operate an artificial recharge plant. Water quality, particularly suspended load, is the main factor of the analysis. Drying of mud crusts after floods, and wind erosion during summer could explain the continuous recharge of arid zone aquifers in spite of alluvial deposition of mud on recharge areas during floods. The Oued Biskra, Algeria study gives an example of such a process and shows the smoothing of a discontinuous recharge into a continuous discharge through an underground reservoir. Moreover this example shows that artificial recharge can be induced by modifying the initial natural state by pumping. By means of an analog RC network it has been possible to find the optimal value of exploitable discharge of the system by computing the daily natural rate of recharge into the reservoir from observed variations of water level caused by flooding. (Knapp-USGS)
W70-04353

COMPARISON OF LABORATORY AND FIELD ANALYSES OF AQUIFER AND WELL CHARACTERISTICS AT AN ARTIFICIAL RECHARGE WELL SITE,
Geological Survey, Denver, Colo.; and Geological Survey, Little Rock, Ark.
For primary bibliographic entry see Field 02F.
W70-04354

ARTIFICIAL-RECHARGE EXPERIMENTS UTILIZING RENOVATED SEWAGE-PLANT EFFLUENT - A FEASIBILITY STUDY AT BAY PARK, NEW YORK, U.S.A.,
Geological Survey, Mineola, N.Y.
For primary bibliographic entry see Field 05D.
W70-04355

ARTIFICIAL RECHARGE FOR PUBLIC WATER SUPPLIES IN URBANIZED REGIONS,
Technische Hogeschool, Delft (Netherlands). Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 05F.
W70-04356

HYDROGEOLOGICAL STRUCTURES AND WATER RESOURCE REGULARIZATION (IN FRENCH),
Gilbert Castany.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 413-425, 1967. 13 p, 9 fig, 2 tab, 13 ref.

Descriptors: *Water storage, *Regulation, *Reservoirs, *Artificial recharge, Hydrogeology, Aquifers, Injection wells, Water spreading, Forecasting.
Identifiers: France, Algeria, Tunisia.

Irregularity of surface water supplies and, to some extent, groundwater supplies, necessitates some form of water regulation reservoir use for efficient regional development. Surface reservoirs or groundwater recharge may be used. Examples are given of the use of groundwater reservoirs for regulation storage in France, Algeria, and Tunisia. To use underground storage, a thorough knowledge of the hydrogeology of the area is necessary. (Knapp-USGS)
W70-04360

ECONOMIC ASPECTS OF CONJUNCTIVE USE OF WATER, SMITH VALLEY, NEVADA, USA,
Nevada Bureau of Mines, Reno. Desert Research Inst.
Patrick A. Domenico.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 474-482, 1967. 9 p, 6 fig.

Descriptors: *Water resources development, *Conjunctive use, *Nevada, *Economics, Aquifers, Streams, Groundwater, Surface waters, Optimum development plans, Water management (Applied), Water supply.
Identifiers: *Smith Valley (Nev).

Supplemental irrigation wells in Smith Valley, Nevada, USA, are individually owned and operated and their use is permitted in conjunction with surface water for irrigation of about 6300 acres whereas an additional 8700 acres have surface-water rights only. Owing to the developed capacity of the wells, most conjunctive appropriators are virtually assured of a full supply of irrigation water every season regardless of the availability of surface water. Predicted on the basis of historic flow and well yield and assuming centralized control of the well fields for the benefit of the entire valley, the existing pumping facilities could provide about 93% assurance of a full supply of irrigation water for all appropriators. Thus, the problem reduces to one of a proper scale of operation. Analysis based on returns from ranching and cost of supplemental water for various levels of demand, efficiency, and lift, suggests that more groundwater could be pumped cheaper with the existing pumping facilities if the operation were centralized instead of under individual control. (Knapp-USGS)
W70-04363

MATHEMATICAL SIMULATIONS FOR BETTER AQUIFER MANAGEMENT,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06A.
W70-04364

GROUNDWATER LEVELS IN NEW MEXICO, 1965, AND CHANGES IN WATER LEVELS, 1961-1965,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02F.
W70-04390

'ONE HUNDRED AND TWENTY-THREE FEET LONG': THE HORIZONTAL WELL AS A NEW METHOD OF RANGE WATER DEVELOPMENT,
Arizona Univ., Tucson. Cooperative Extension Service.
W. T. Welchert, and Barry N. Freeman.
Progressive Agriculture in Arizona, Vol 21, No 6, p 8-11, November-December 1969. 6 fig.

Descriptors: *Wells, *Stock water, *Range management, *Hydrogeology, *Perched water, *Drilling, Drilling equipment, Arizona, Arid lands, Logging (Recording).
Identifiers: *Horizontal wells, San Carlos Indian Reservation, Arizona.

The introduction of horizontal well drilling could revolutionize stock water development in Arizona and the West. Dirt tanks, trick tanks, and conventional wells are either unreliable, expensive, or require a great deal of maintenance. All of these problems are overcome with horizontal wells. The wells are 'cased springs' and require no power system to pump and dispense the water. This is due to the tapping of water trapped in dike formations or perched water tables. The drilling process and pumbing installation are both very simple. Total development cost for the well installations average $500.00 per site. Among the advantages of the horizontal wells are: very small water loss; low-cost maintenance; small initial investment; sanitary water supply; and greater chance of developing a successful well. (Carr-Arizona)
W70-04396

A WORLD GEOGRAPHY OF IRRIGATION,
For primary bibliographic entry see Field 03F.
W70-04404

KHARGA, FROM THE OASIS MAGNA TO THE NEW VALLEY (IN GERMAN),
For primary bibliographic entry see Field 03F.
W70-04412

WELLS AND WASTES.

Va Code Ann secs 45.1-131, 45.1-136 (1967).

Descriptors: *Virginia, *Wells, *Water sources, *Oil reservoirs, Legislation, Well casings, Drilling, Subsurface waters, Oil wells, Water wells, Drill holes, Groundwater, Springs, Water supply, Municipal water, Water works, Oil, Natural gas, Subsurface drainage, Water pollution sources.

An unproductive gas or oil well may be developed as a source of water upon the request of the owner of the well property. The driller should be paid a reasonable sum by the person desiring a water well for the casing and tubing left in the well. Oil may not be stored or accumulated where it may seep into openings in the bedrock, springs or water wells, or into the public water supply. (Douberley-Florida)
W70-04471

4C. Effects on Water of Man's Non-Water Activities

RUNOFF FROM FOREST AND AGRICULTURAL WATERSHEDS,
Colorado State Univ., Fort Collins. Natural Resources Center.
For primary bibliographic entry see Field 02A.
W70-04055

STORM RUNOFF FROM FORESTED CATCHMENTS BY SUBSURFACE ROUTES,
Forest Service (USDA), Columbus, Ohio. Northeastern Forest Experiment Station.
For primary bibliographic entry see Field 02G.
W70-04065

PRELIMINARY DETERMINATIONS OF HYDROBIOLOGICAL CONDITIONS IN THE VICINITY OF THE PROPOSED JETPORT AND OTHER AIRPORTS IN SOUTH FLORIDA, JULY 1969,
Geological Survey, Tallahassee, Fla.
Benjamin F. McPherson.
Geological Survey Open-file Report, Feb 1970. 31 p, 2 fig, 11 tab, 4 ref, append.

Descriptors: *Water quality, *Swamps, *National parks, *Florida, *Airports, Surveys, Wetlands, Aquatic environment, Water pollution effects, Aquatic habitats, Urbanization, Conservation.
Identifiers: Everglades, Everglades National Park.

Because of concern over the possible hazards posed by the Miami Jetport for Everglades National Park and the surrounding environment of south Florida, water quality data were collected before its opening. As Everglades National Park depends on a certain seasonal flow of unpolluted water, knowledge of the flow and quality conditions are needed so that any development to the north be designed to avoid causing ecological damage. Before any assessment of biological or water-quality changes can be made, pre-flight conditions must be known. Twenty-two stations were selected and sampled in April and July 1969. Three of these were at canals near existing commercial airports farther east. The remaining stations were located within a 30-mile radius of the Jetport. This report gives the results from the samples collected in July. (Knapp-USGS)
W70-04078

METROPOLITAN AREA DEFINITION: A RE-EVALUATION OF CONCEPT AND STATISTICAL PRACTICE,
Chicago Univ., Ill. Dept. of Geography.
For primary bibliographic entry see Field 06B.
W70-04171

GALVESTON BAY: TEST CASE OF AN ESTUARY IN CRISIS,
For primary bibliographic entry see Field 05C.
W70-04432

AN APPRAISAL OF A LAKE MICHIGAN SITE FOR CHICAGO'S THIRD AIRPORT.
Department of Public Works, Chicago, Ill.

Harza Engineering Co., Chicago, Ill., 1967. 49 p, 1 map, 5 fig, 2 photo, 1 append, 3 tab.

Descriptors: *Airports, *Lake Michigan, Dikes, Economic feasibility, Wave pile-up, Sand bars, Water quality, Sediment distribution, Cost comparisons, Access routes.
Identifiers: *Engineering feasibility, Polders.

The preliminary findings of five major categories of planning studies are presented in this report: (1)

establishment of basic requirements; (2) preliminary project design; (3) site investigations; (4) construction materials, methods and schedules ; and (5) estimate of cost. Consultants to the City of Chicago in the process of establishing the requirements for aviation, environment and navigation included: (1) Landrum and Brown, aviation consultants; (2) the Federal Aviation Agency; (3) the Federal Water Pollution Control Administration; (4) the Corps of Engineers; and the U.S. Army-Chicago District. The preliminary findings indicate that the development of an airport site in Lake Michigan is technically feasible. The costs estimates, prepared on the basis of a four year construction period, indicate that the construction cost will be about $247 to $284 million. This estimate is based on a site centered 5 1/2 miles east of Lake Shore Drive at 31st Street. Estimates are also given for three other locations and for an airport area larger than the one detailed in this report. (See also W70-04440 thru W70-04443). (Starr-Chicago)
W70-04439

CHAPTER 2: DESCRIPTION.
Department of Public Works, Chicago, Ill.

In: An Appraisal of a Lake Michigan Site for Chicago's Third Major Airport, Harza Engineering Co., Chicago, Ill., 1967. p 4-8.

Descriptors: *Airports, *Lake Michigan, Dikes, Access routes, Locating.
Identifiers: *Engineering feasibility, Polders.

For the purpose of this report, it has been assumed that the lake airport site would be circular in plan and have a diameter four miles enclosing 8,000 acres and would be located between 12th Street and 45th Street with two approaches: (1) a causeway and bridge from the Stevenson Expressway; and (2) a tunnel from 31st Street. The definite designs presented here are for the purpose of cost estimation, determination of feasibility, and evaluation of construction materials, methods and schedules; the final location will depend upon the recommendations of the FAA and the city's aviation consultants. The dominating element in the Lake Michigan Airport will be the enclosure dike; the height will vary from 50 to 80 feet and its dumping silty or clayey sands in the central part of the embankment. Sanitary sewage and runoff from the surfaced airport area will be collected separately without pollution of the lake in a detention pond with a minimum surface area of approximately 200 acres and an additional area reserved for water storage during precipitation periods. (See also W70-04439). (Starr-Chicago)
W70-04440

CHAPTER 4: CONSTRUCTION.
Department of Public Works, Chicago, Ill.

In: An Appraisal of a Lake Michigan Site for Chicago's Third Major Airport, Harza Engineering Co., Chicago, Ill., 1967. p. 24-36, 1 tab.

Descriptors: *Airports, *Lake Michigan, *Economic feasibility, Time.
Identifiers: *Engineering feasibility.

Considered in this chapter are the questions of construction feasibility and time. The results of surveys carried out to find the answers to these questions are presented. The purpose of these surveys was to determine: (1) if sufficient materials are available within practical distances and (2) the cost of obtaining, transporting and placing the materials. Future studies will attempt to define specific areas from which materials can be obtained and transported at minimum cost. Maps prepared by the Illinois Geological Survey indicate that there are many areas in northeastern Illinois with sizeable sand and gravel deposits. A side benefit that could be obtained from the use of Illinois resources is the possibility of forming large recreational lakes. The methods used to construct the lake airport will influence the project design, cost and construction time. Research will be done into special handling methods; but an assumption has been made during this appraisal phase that conventional equipment and construction methods would be used. (See W70-04439). (Starr-Chicago)
W70-04441

CHAPTER 5: COST.
Department of Public Works, Chicago, Ill.

In: An Appraisal of a Lake Michigan Site for Chicago's Third Major Airport, Harza Engineering Co., Chicago, Ill., 1967. p 37-42, 3 tab.

Descriptors: *Airports, *Lake Michigan, *Economic feasibility, Location, Access routes, Cost comparison.
Identifiers: *Engineering feasibility.

The total construction cost of this plan for the lake airport is estimated to be in the range of $247 to $284 million. A description is given in this chapter as to how the costs were estimated, and the estimated costs at three alternative locations are also presented in table form. None of the information presently available indicates that movements of the site for distances up to three miles in a northerly or southerly direction, parallel to the shoreline would cause a significant change in cost. For a more easterly location farther out into the lake, the costs would increase inasmuch as more fill would be required for higher embankments, wave action would be more severe, and access facilities would have to be longer. An accompanying table indicates that the incremental cost per acre decreases rapidly with increasing airport size. (See W70-04439). (Starr-Chicago)
W70-04442

CHAPTER 6: FUTURE STUDIES.
Department of Public Works, Chicago, Ill.

In: An Appraisal of a Lake Michigan Site for Chicago's Third Major Airport, Harza Engineering Co., Chicago, Ill., 1967. p 43-49.

Descriptors: *Airports, *Lake Michigan, Project planning, Sand bars, Clay loam, Gravels, Sands, Dike, Access routes.
Identifiers: *Engineering feasibility.

Future planning for the Lake Michigan Airport will depend to a degree upon the recommendation of FAA and city aviation consultants in regard to the location and size of the airport. There are two broad categories of future planning investigations: (1) field work to map the lakebed in the project area, exploration of foundation conditions, inventory of available materials, and laboratory analyses of the resulting data; and (2) verification and refinement of project designs so as to focus on environmental effects of the lake project and on the dike and access designs. The study of environmental effects will be done by means of hydraulic model testing and the collection of additional field data to supplement existing information. A small-scale model of the airport vicinity will be built to study the effect of the airport upon lake currents. Additional data will be obtained by measuring actual current velocities in the lake and by taking samples of lake water for an analytical study of the water quality. (See W70-04439). (Starr-Chicago)
W70-04443

4D. Watershed Protection

SOIL CONSERVATION DISTRICTS.

Va Code Ann secs 21-1 thru 21-5 (1960).

Descriptors: *Virginia, *Soil conservation, *Agricultural engineering, *Erosion control, Legislation, Water conservation, Soil erosion, Sediment control, Runoff, Irrigation engineering, Drainage, Flood prevention, Dams, Channel improvement, Public health, Reservoirs, Soil contamination, Soil management, Soil stabilization, Multiple-purpose projects, Agriculture, Flood control, Terracing, Contours.

The policy of the legislature is to provide for the conservation of soil resources, for the control and prevention of soil erosion, for the prevention of floodwater and sediment damages, and for furthering agricultural phases of water conservation. In so doing, the legislature intends to preserve natural resources, control floods, prevent impairment of dams and reservoirs, maintain the navigability of rivers and harbors, preserve wildlife, protect public land, and promote the general health, safety, and welfare of the people. A detailed list of the conditions and consequences leading to this legislative determination is included. Among these are soil erosion in the form of destructive sedimentation, increased flooding, and deterioration of soil and crops caused by improper land-use practices. Appropriate corrective methods, including land-use reforms, soil conservation practices, and engineering improvements, are endorsed. A section of definitions is included. Cooperation among soil conservation districts and between these districts and state agencies is authorized and prescribed. (Schram-Florida)
W70-04221

DRAINAGE AND SOIL CONSERVATION.
Va Code Ann secs 21-53 thru 21-57, 21-59 thru 21-62, 21-65 (1960), as amended, (Supp 1968).

Descriptors: *Virginia, *Soil conservation, *Water conservation, *Administrative agencies, Legislation, Demonstration farms, Erosion control, Land resources, Drainage, Irrigation, Soil erosion, Flood prevention, Water districts, Damages, Structures, Agricultural engineering, Cultivation, Sediment control, Multiple-purpose projects, Soil investigations, Soil management, Fertilizers, Seeds, Farm equipment.
Identifiers: *Conservation districts.

Soil and water conservation districts are authorized to conduct surveys and research relating to: (1) the character of soil erosion and floodwater and sediment damages; (2) agricultural phases of the conservation, utilization, and disposal of water; and (3) the preventive and control measures and improvements needed. They may publish their findings, disseminate information, and conduct demonstrational projects. These districts are authorized to carry out preventive and control measures for flood prevention or agricultural water conservation. These activities may be carried out on state lands or other lands within the district with the consent of the owner. The districts may offer financial aid and cooperation to land occupiers to carry out the objectives of this act. The districts may make agricultural and engineering machinery, fertilizer, seeds, and other equipment available to land occupiers within the district to assist in the prevention and control of soil erosion and for flood prevention. The districts may construct, improve, operate, and maintain all necessary or convenient structures for the purpose of this act. They may develop comprehensive plans and programs for soil and water conservation and may acquire and administer water and soil conservation projects. For these purposes, they may operate as agencies of the state or of the United States. (Schram-Florida)
W70-04223

MISSOURI WATERSHED PROTECTION AND FLOOD PREVENTION LAW.

Mo Ann Stat secs 278.160 thru 278.300 (1963), as amended, (Supp 1970).

Descriptors: *Missouri, *Watershed management, *Flood control, *Water districts, Erosion control, Flood protection, Soil management, Legislation, Adjudication procedures, Administrative agencies, Administration, Taxes, Assessments, Financing, State governments, Federal government, Coordina-

tion, Recreation, Disposal, Agriculture, Sediment control, Drainage, Consolidation, Industries, Irrigation.

Subdistricts of soil and water conservation districts may be formed for purposes of: (1) carrying out watershed and flood prevention programs; (2) preventing floodwater and sediment damages; (3) furthering the conservation, development, utilization and disposal of water; (4) increasing recreation and industry development; and (5) developing agricultural water management, irrigation and drainage. This act provides for: (1) the prescription of subdistrict establishment procedures by the State Soil and Water Districts Commission; (2) feasibility studies, hearing and referendum procedures; (3) government of subdistricts by boards of soil and water conservation district supervisors; (4) subdistricts located in more than one district; (5) an initial organization tax and annual taxes; (6) consolidation of two or more subdistricts; (7) expansion of subdistricts; (8) cooperation with federal programs; (9) assessments; and (10) disestablishment of subdistricts and their subsequent control by the State Soil and Water Districts Commission. (Marsee-Florida)
W70-04232

DELAWARE RIVER BASIN COMPACT (WATERSHEDS, RECREATION, HYDROELECTRIC POWER, FINANCING, GENERAL PROVISIONS).
For primary bibliographic entry see Field 06B.
W70-04361

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

APPLICATION OF RADIOISOTOPE TECHNIQUES TO A CRITICAL WATER RESOURCES PROBLEM AREA - NAMELY NUTRITIONAL POLLUTION,
Oklahoma Univ., Norman. Dept. of Civil Engineering and Sanitary Science; and Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
George W. Reid, Robert A. Gearheart, James M. Robertson, and Robert M. Sweazy.
Available from the Clearinghouse as PB-189 793, $3.00 in paper copy, $0.65 in microfiche. Oklahoma State University Water Resources Research Institute Project Completion Report, 1969. 14 p, 1 fig, 1 tab, 1 append. OWRR Proj No A-011-OKLA.

Descriptors: *Eutrophication, *Nutrients, *Phosphorus compounds, Algae, Phosphates, Nitrates, Sewage effluents, Tertiary treatment, Water pollution sources, Water pollution effects, Laboratory tests, Model studies, Radioactivity techniques, Tagging.
Identifiers: Nutrient requirements (Algae).

Minimal concentrations of nitrogen and phosphorus necessary for the growth of algae were studied. A radioactive phosphorus method was used as one of the parameters for biological mass produced and phosphorus uptake rate in alga culturing unit. All other necessary inorganic and organic nutrients, including vitamin B-12 and other growth metabolites, were supplied in excess to allow maximum algae reaction to the nitrogen and phosphorus. The relationship between nitrogen, phosphorus and algal growth is expressed by a multiple regression analysis procedure. A bacterial bloom occurs within the second or third day in contrast to the algae growth which usually requires 6 to 8 days. The soluble phosphate is taken up 80-90% in the first day. At a phosphate concentration of 0.10 mg/l, the algal bloom condition threshold is reached. Regardless of the nitrogen concentration, this narrow range of sensitivity to the phosphorus concentration demonstrates the problem in attempting to control nutritional pollution. (Knapp-USGS)
W70-04074

COMPOSITION OF INTERSTITIAL WATERS OF MARINE SEDIMENTS: TEMPERATURE OF SQUEEZING EFFECT,
Southern California Univ., Los Angeles.
For primary bibliographic entry see Field 02K.
W70-04075

CHEMISTRY OF NITROGEN AND PHOSPHORUS IN WATER,
For primary bibliographic entry see Field 05C.
W70-04080

THE CALCULATION OF THE ACUTE TOXICITY OF MIXTURES OF POISONS TO RAINBOW TROUT,
Water Pollution Research Lab., Stevenage (England).
V. M. Brown.
Water Research, Vol 2, p 723-733, 1968. 8 fig, 2 tab, 20 ref.

Descriptors: *Ammonia, *Phenols, *Copper, *Bioassay, Hydrogen ion concentration, Water chemistry, *Water analysis, *Analytical techniques, Alkalinity, Water pollution effects, Toxicity, Lethal limit, Laboratory tests.
Identifiers: *Zinc, *Cadmium, *Lead, *Nickel, *Hydrogen cyanide, *Pollutant mixtures.

The estimation of the acute toxicity to trout of mixtures of the common industrial pollutants ammonia, phenol, zinc, copper, cadmium, lead nickel, and hydrogen cyanide is described. This is done from a knowledge of the concentrations of these poisons and of the temperature, pH value, total hardness, bicarbonate alkalinity, total dissolved solids concentration, and dissolved-oxygen concentration of the dilution water. The toxicity of the mixture is taken to be the sum of the proportions of the acutely toxic concentration of each poison. The assumptions made in the use of this method are discussed along with its limitations, and the fact that in critical areas of study, such estimates can never be substitutes for the actual determination of the toxicity of a water by the use of fish is stressed. (Sjolseth and Katz-Washington)
W70-04156

U.S. GEOLOGICAL SURVEY WATER-QUALITY DATA IN THE WILLAMETTE BASIN, OREGON, 1910-64,
Geological Survey, Portland, Oreg.
For primary bibliographic entry see Field 02K.
W70-04261

NUTRIENTS AND OTHER FORMS OF POLLUTION,
Minnesota Dept. of Conservation. Waters Section.
For primary bibliographic entry see Field 05C.
W70-04267

KEYS TO WATER QUALITY INDICATIVE ORGANISMS (SOUTHEASTERN UNITED STATES),
Toronto Univ. (Ontario). Dept. of Zoology.
R. O. Brinkhurst.
US Dep of the Interior, Federal Water Pollution Control Administration, undated. 17 p, 14 fig, 6 ref.

Descriptors: *Oligochaetes, *Water quality, Fresh water, Great Lakes region, Habitats, Tubificids, Water pollution, Sludge worms.
Identifiers: *Taxonomic key, North America East of Rocky Mountains, Acolosomatidae, Naididae, Enchytraeidae, Lumbriculidae, Opistocystidae, Setae, Branchiobdellidae, Bifid crotchets.

In identifying the Oligochaeta, by making keys to the most important family, the Tubificidae, and proceeding directly to species without keying out the genera, it has become possible to identify specimens from simple whole-mounts. About half of the Tubificidae may be identified from immature speciments; mature specimens are required for the rest--mature specimens are usually present in any community. These worms are hermaphrodite, with no larval stages. Upon studying the serial sections and the worms placed in the proper genera, species can often be fitted into the key using only superficial characters recognizable in whole-mounts. Good results depend on proper preparation and examination of material and understanding the salient anatomical features used in the key. Method of preparation and preservation is given. Principal features are the several types of setae. Bifid crotchets are found in both dorsal and ventral bundles in Naididae, Tubificidae and Lumbriculidae. A generalized plan of genitalia of a tubificid is given. Descriptions of various families, listing the approximate number of species in freshwaters east of the Rocky Mountains, and their normal habitats may be of more immediate value than the formal key given. (Jones-Wisconsin)
W70-04281

INFLUENCE OF METHOD FOR REMOVAL OF SESTON ON THE DISSOLVED ORGANIC MATTER,
Washington Univ., St. Louis, Mo. Dept. of Botany.
For primary bibliographic entry see Field 07B.
W70-04285

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME II.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04300

CHEMICAL AND RADIOCHEMICAL ANALYSES OF WATER FROM STREAMS, RESERVOIRS, WELLS, AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 02K.
W70-04307

DEVELOPMENT OF A METHOD FOR THE TOTAL COUNT OF MARINE BACTERIA ON ALGAE,
McGill Univ., Montreal (Quebec). Dept. of Microbiology and Immunology; and New Brunswick Univ., Fredericton. Dept. of Biology.
E. C. S. Chan, and Elizabeth A. McManus.
Canadian Journal of Microbiology, Vol 13, p 295-301, 1967. 2 fig, 3 tab, 10 ref.

Descriptors: *Marine bacteria, *Algae, *Analysis, *Analytical techniques, Temperature, Piptides, Intertidal areas, Soil bacteria, Laboratory tests.
Identifiers: *Algae homogenization, *Bacteria count, Waring Blendor mortality, Cell wall, Hexosamine, Ascophyllum nodosum, Polysiphonia lanosa, Point Lepreau (Canada), New Brunswick (Canada), Servall Omni-Mixer homogenizer.

In an initial attempt to develop a technique for enumeration of bacteria on littoral algae, it was observed that homogenization of algal samples in the Waring Blendor resulted in mortality of marine bacteria samples, apparently due to singular susceptibility to manipulations. Further work on this lethal effect of blending showed two detrimental factors, heat and mechanical injury of the cells, were implicated: due to the increase in temperature during homogenization (temperatures slightly beyond 35C result in rapid bacterial killing) and the high speed rotation of the knife-blade assembly of the Waring Blendor. These findings resulted in a satisfactory technique for obtaining homogenates of marine materials to obtain total bacteria count

by using a Servall Omni-Mixer homogenizer at speeds of about 5000 revolutions per minute and temperature of homogenization not exceeding 30C. With this method, it was possible to make an extensive study of ecology of marine bacteria on Polysiphonia lanosa and Ascophyllum nodosum, the former alga growing epiphytically on Ascophyllum. (Jones-Wisconsin)
W70-04365

ANALYTICAL CHEMISTRY OF PLANT NUTRIENTS,
Wisconsin Univ., Madison. Water Chemistry Lab.
G. Fred Lee.
Eutrophication: Causes, Consequences, Correctives. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. p 646-658. 3 fig, 3 tab, 22 ref.

Descriptors: *Analytical techniques, *Aquatic weeds, *Water analysis, *Sampling, Plant physiology, Eutrophication, Data collection, Chemical analysis, Reliability, Water pollution, Water pollution effects, Nitrogen, Phosphorus, Algae, Nutrients, Water properties.
Identifiers: *Nutrient elements, Phosphorus release, Sample preservation, Water dynamics, Water constituents, Analytical chemistry, Waste water effects, Lake Mendota (Wis), Black Earth Creek (Wis).

Various steps must be taken to achieve rational management of water basins invaded or threatened by noxious aquatic weeds. The first phase of an eutrophication study involves a decision on the method, location, and frequency of sampling, and the manner of sample preservation. Next, is the selection of methods of analyses appropriate to the required accuracy of results. Finally, a critical evaluation of results obtained as to their general reliability and statistical significance. Detailed information on sources, forms, and methods of analysis applicable to nitrogen and phosphorus are given. Addition of mercuric chloride and freezing to -20C, rather than the use of chloroform and hydrogen sulfate, is recommended for the preservation of nitrogen forms and phosphorus compounds in stored water samples. A warning is given about possibility phosphate loss due to sorption by glass or plastic containers. (See Vol. 3, No. 10, Field 5C, W70-03975). (Wilde-Wisconsin)
W70-04382

A SIMPLE PIPETTE CONTROL FOR ISOLATING PLANKTONIC ALGAE,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
Brenda J. Boleyn.
Canadian Journal of Microbiology, Vol 13, p 1129-1130, 1967. 1 fig, 4 ref.

Descriptors: *Algae, *Analytical techniques, *Plankton, *Laboratory tests, *Isolation, *Control, Methodology, Cultures, Testing, Capillary conductivity, Bacteria, Diatoms, Test procedures.
Identifiers: *Pipette, Unialgal, Nitzschia, Algae isolation, Capillarity, Capillarity control device.

A device for simplifying the isolation of plankton or other small particles has been developed. It operates by controlling the capillarity of the fine-tipped pipette routinely used for phytoplankton isolation. The inward and outward flow of fluid may be controlled smoothly and completely. There are a number of advantages in this device over the unmodified isolating pipette. A steady hand is easily maintained since the hand guiding the pipette need not control capillarity also. The operator is able to nudge and steer reluctant or adhering forms into the pipette, especially where long slender cells, setose forms, or chain-formers might easily cluster and occlude the tip. A pipette with an orifice of small or large size may be used, making it helpful to isolate large or peculiarly shaped cells. The explosive nature of pipette delivery is lessened and bubbling is prevented. Motile organisms may be followed and caught readily. The entire procedure is hastened, diminishing danger of thermal shock, especially important for winter forms. Also the risk of producing appreciable salinity changes is minimized. (Jones-Wisconsin)
W70-04469

A WATER CORE PLANKTON SAMPLER,
South Dakota Cooperative Fishery Unit, Brookings.
Richard L. Applegate, Alfred C. Fox, and Victor J. Starostka.
Journal Fisheries Research Board of Canada, Vol 25, No 8, p 1741-1742, 1968. 1 fig.

Descriptors: *Cores, *Plankton, *Sampling, Population, Zooplankton, Ice, Columns, Depth, Ponds, Lakes, Seasonal Littoral.
Identifiers: Vertical sampling.

A rapid method for quantitative sampling of net plankton populations was provided by a device constructed from irrigation pipe. It was developed for collecting zooplankton under ice cover, when metered townets could not be conveniently used. Error associated with back-flushing when a plankton net is drawn through a vertical water column is eliminated, thus the quantity of net plankton can be determined accurately. Consisting of 152-millimeter-diameter aluminum pipe, the sampler is light weight, simple to operate, and economical. The hinged bottom section to which the net is attached, is held open by a line attached to the bucket. The net is brought into the filtering position by pulling the lazy-line after the sampler is lowered to the desired depth. As the sampler is raised and the column of water strained, the net is fixed in place by a spring latch. By adding or removing sections of pipe, the sampler can be adapted for any depth, making it a convenient tool for sampling net plankton populations in ponds and littoral areas of lakes throughout all seasons. (Jones-Wisconsin)
W70-04489

5B. Sources of Pollution

COMPUTER SIMULATION OF WASTE TRANSPORT IN GROUNDWATER AQUIFERS,
Colorado State Univ., Fort Collins. Natural Resources Center.
D. L. Reddell, and D. K. Sunada.
Available from the Clearinghouse as PB-189 769, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 13 p, 8 ref. OWRR A-001-COLO.

Descriptors: *Computer models, *Groundwater, *Dispersion, *Waste dilution, Water pollution sources, Numerical techniques, Saline water freshwater interfaces.

A computer simulation of the convective-dispersive process of the movement of pollutants in groundwater systems was developed and tested for several conditions. An implicit numerical technique was used to solve the flow equation and the method of characteristics used to solve the convective-dispersion equation. The model was tested by applying it to longitudinal dispersion problem and the longitudinal and lateral dispersion problem. The tensorial nature of the dispersion coefficient was demonstrated by solving a problem in the rotated coordinate system. The model was successfully used to solve the salt-water interface problem.
W70-04051

BOUNDARY EFFECTS ON JET FLOW PATTERNS RELATED TO WATER QUALITY AND POLLUTION PROBLEMS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-04068

POTOMAC ESTUARY MATHEMATICAL MODEL,
Federal Water Pollution Control Administration, Annapolis, Md. Chesapeake Field Station.
Leo J. Hetling.
Water and Sewage Works, Vol 117, No 2, p 47-51, Feb 1970. 5 p, 7 fig, 8 ref.

Descriptors: *Systems analysis, *Mathematical models, *Estuaries, Water management (Applied), Research and development, Water quality, Water yield, Water supply, Flow, Path of pollutants, Water pollution control, Waste water treatment.
Identifiers: Potomac River, Potomac Estuary.

Publications concerning systems analyses and mathematical modeling of the Potomac Estuary are reviewed and discussed briefly. A systems analysis approach has been undertaken by the Federal Water Pollution Control Administration (FWPCA) in investigating the water quality responses in the Potomac River basin. The analyses included the effects of low flow augmentation, wastewater diversions, water supply withdrawals, and increased degrees of wastewater treatment on water quality in the upper estuary. Several techniques of mathematical models capable of simulating the response of water quality in an estuary were available when the study of the Potomac Estuary was undertaken in 1965. The segmented estuary model developed by Thomann was selected as the one which most closely conformed to the requirements of the study. The segmented model is highly flexible and capable of being utilized to describe almost any pollutant. Its accuracy is adequate for engineering design purposes. Properly programmed, the digital computer makes possible solutions of the systems available in minutes at a relatively small cost. (Knapp-USGS)
W70-04077

FRESHWATER ECOLOGICAL STUDIES IN PANAMA AND COLUMBIA,
Battelle Memorial Inst., Richland, Wash. Environmental and Life Sciences Div.
W. L. Templeton, J. M. Dean, D. G. Watson, and L. A. Rancitelli.
BioScience, Vol 19, No 9, p 804-808, 1969. 2 fig, 4 tab, 5 ref.

Descriptors: *Ecosystems, *Rivers, Chemical analysis, Fish, Crustaceans, Reptiles, Gastropods, Radiation, Nuclear engineering.
Identifiers: *Nuclear excavations, *Panama, *Colombia, *Radionuclides, Activation analysis, Specific activity, Concentration factors, Radiation dose, South America, Tissue analysis, Vegetation canopy.

Studies were made to acquire data for evaluation and prediction of potential radiation dose to indigenous populations in the region of proposed nuclear excavations. Freshwater rivers and streams supply water for domestic use and food in forms of fish, reptiles, and macroinvertebrates; in areas accessible to the sea, marine food organisms are preferred over freshwater forms. Daily consumption is estimated at 100 grams aquatic food and 4 liters water. Collections were made at 19 stations in Panama and 15 stations in Colombia; chemical and activation analyses were made of water, suspended solids, and tissue. Low concentrations of elements suggest high capacity for retention and cycling in terrestrial-soil ecosystem. Interflow predominates over sheet run-off. Water samples show relatively high concentrations of sodium, magnesium, cobalt, chromium, and cesium and low concentrations of potassium, iron, and antimony compared with mean values for all rivers. Concentration factors of stable elements vary with tissue analyzed, being highest for phosphorus, mercury, potassium, and copper. Contribution of direct fallout to freshwater ecosystem is likely to be small owing to vegetation canopy. Occurrence of peak concentrations will depend on rate of movement through terrestrial and groundwater systems; these should dampen the peaking effect. (Voigtlander-Wisconsin)
W70-04182

RELATIONSHIP BETWEEN BACTERIA, NUTRIENTS AND RAINFALL IN SELECTED BODIES OF FRESH WATER,
Florida Inst. of Tech., Melbourne. Univ. Center for Pollution Research.
For primary bibliographic entry see Field 02H.
W70-04189

POLLUTION AT THE SOUTHERN END OF LAKE MICHIGAN (WATER POLLUTION),
James C. Vaughn.
Am Water Wks Ass'n J, Vol 61, No 11, p 603-609, Nov 1969. 7 p, 1 ref.

Descriptors: *Water pollution, *Water quality control, *Water pollution sources, *Pollution abatement, Treatment facilities, Aquatic micro-biology, Impaired water quality, Pollutant identification, Water pollution treatment, Water pollution effects, Plankton, Aquatic bacteria, Direct costs, Effluents, Administration, Statistics, Sampling, Industrial wastes, Chemical wastes, Sewage treatment.
Identifiers: Treatment costs.

The Chicago-Southern Lake Michigan areas has a long history of battling water pollution. Various administrative boards--state, regional, and federal--have been formed to deal with the problem. Material presented at conferences of these boards reveals the scope of the pollution problem. Domestic sewage pollution has been somewhat alleviated, but data collected from the several sampling points in the Chicago metropolitan area and in Lake Michigan reveal that chemical and bacterial pollution is still a serious problem. Pollutants such as ammonia nitrogen, coliform organisms, plankton, phenol, and hydrocarbons are much in evidence as shown by several graphs and tables and the prevailing trend is toward more pollution. Rising pollution treatment costs have added to the difficulties. Industrial wastes are increasing, giving rise to the plankton pollution and offensive tastes and odors in the water. The article states that unless there is a quantitative reduction in these industrial wastes, there will be little chance to improve water quality. (Caldwell-Florida)
W70-04211

WATER POLLUTION BY NUTRIENTS-SOURCES, EFFECTS AND CONTROL, PAPERS PRESENTED AT 1966 ANNUAL MEETING OF MINNESOTA CHAPTER SOIL CONSERVATION SOCIETY OF AMERICA.
Minnesota Univ., Minneapolis. Water Resources Research Center.

Available from the Clearinghouse as PB-189 794, $3.00 in paper copy, $0.65 in microfiche. WRRC Bulletin 13, Minnesota Water Resources Research Center, June 1969. 79 p. OWRR Project A-999-MINN.

Descriptors: *Water pollution sources, *Water pollution effects, *Eutrophication, *Nutrients, Algae, Fish population, *Water pollution control, Farm wastes, Municipal wastes, Septic tanks, Recreation wastes, Water quality.
Identifiers: *Nutrient sources.

The Bulletin includes the papers presented at a conference on 'Nutrient Pollution - Sources, Effects and Control' held in Minneapolis, Minnesota on January 8, 1969. The conference was planned as the Annual Meeting of the Minnesota Chapter, Soil Conservation Society of America. The papers, all individually abstracted, include the following titles: Nutrients and Other Forms of Pollution, Diagnosing Pollution in Lake Minnetonka, Effect of Eutrophication on Fish and Related Organisms, Health Aspects, Surface and Groundwaters, Animal Waste Disposal Problems and Trends in Minnesota, Managing Livestock Wastes to Control Pollution, Runoff and Sediment as Nutrient Sources, Controlling Nutrients and Organic Toxicants in Runoff, Treatment of Municipal Wastes, Septic Tank Effluents, Water Pollution in Recreational Areas - Sources and Control, and Setting Water Quality Standards and Regulating Nutrient Sources, Implementing Pollution Control.
W70-04266

RUNOFF AND SEDIMENT AS NUTRIENT SOURCES,
Agricultural Research Service, Morris, Minn. North Central Soil Conservation Research Center.
For primary bibliographic entry see Field 05C.
W70-04272

CONTROLLING NUTRIENTS AND ORGANIC TOXICANTS IN RUNOFF,
Minnesota Univ., Minneapolis. Dept. of Soil Science.
For primary bibliographic entry see Field 05C.
W70-04273

SEPTIC TANK EFFLUENTS,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05C.
W70-04275

WATER POLLUTION IN RECREATIONAL AREAS--SOURCES AND CONTROL,
Forest Service (USDA), Ely, Minn. Superior National Forest.
For primary bibliographic entry see Field 05C.
W70-04276

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME II.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04300

COMPUTER MODEL OF CONNECTICUT RIVER POLLUTION,
United Aircraft Corp., East Hartford, Conn. Research Labs.
Thomas E. Hoover, and Robert A. Arnoldi.
Journal Water Pollution Control Federation, Vol 42, No 2, Part 2, p R67-R75, Feb 1970. 9 p, 4 fig, 1 tab, 11 ref.

Descriptors: *Water pollution, *Rivers, *Computer models, *Connecticut, Mathematical models, Stochastic processes, Statistical methods, Path of pollutants, Water pollution treatment, Water pollution control, Biochemical oxygen demand, Sewage treatment, Thermal pollution, Dissolved oxygen.
Identifiers: Connecticut River.

A computer model designed to reproduce the physcial and chemical processes in the Connecticut River was used to predict the effects of wastewater disposal, aeration, and thermal pollution on the DO and BOD in the river. Actual chemical and physical input data used for the construction of the model were obtained from six independent sources. The DO and BOD concentrations were calculated for a simulation period of 48 hr and presented graphically as a function of time using a special contouring system developed for this study. After the capability of the model was proved by duplicating existing DO and BOD concentration levels in the river, the program was used to demonstrate that a reduction in the wastewater dumped into the river would produce a significant improvement in water quality, whereas aeration would produce only a minimal improvement. River modeling techniques using actual data may be useful in water quality management. (Knapp-USGS)
W70-04302

PARATHION DEGRADATION IN LAKE SEDIMENTS,
Wisconsin Univ., Madison. Dept. of Soil Science; and Texas Christian Univ., Fort Worth. Dept. of Geology.
Donald A. Graetz, Gordon Chesters, Tommy C. Daniel, Leo W. Newland, and Gerhard B. Lee.
Journal Water Pollution Control Federation, Vol 42, No 2, Part 2, p R76-R94, Feb 1970. 19 p, 7 fig, 4 tab, 18 ref. OWRR Grant No B-016-WIS, and FWPCA Training Grant No 5T1-WP-100.

Descriptors: *Biodegradation, *Organophosphorus pesticides, *Bottom sediments, Aerobic conditions, Anaerobic conditions, Chemcial reactions, Hydrolysis, Insecticides, Lakes.
Identifiers: Parathion degradation.

Mechanisms and rates of parathion degradation were determined in a sterile sediment, in aerobic and anaerobic 1-percent peptone solutions, in a peptone-enriched sediment system, and intact sediments from two Wisconsin lakes. Chemical degradation involved hydrolysis at the nitrophenyl C-O-P bond resulting in the formation of diethylthiophosphoric acid and p-nitrophenol. The rate of parathion hydrolysis in an aqueous parathion solution containing sterile sediment was 0.15 to 0.18 percent of added parathion per day. Aminoparathion was degraded further under aerobic conditions but not under anaerobic conditions. Parathion degradation was slower in a slightly acid sediment than in a calcareous sediment. Rates of parathion degradation averaged 0.28 percent of added parathion per day in aqueous suspensions containing 90 and 200 mg Lake Tomahawk sediment compared with 0.54 and 0.74 percent of added parathion per day in suspensions containing 0.5 and 1.5 g Nagawicka sediment. (Knapp-USGS)
W70-04303

GROUNDWATER FLOW SIMULATED ON COMPUTER AIDS NUCLEAR PLANT RADIOACTIVE WASTE STUDY,
Battelle-Northwest, Richland, Wash. Water Resources Systems Section.
Robert T. Jaske.
Industrial Water Engineering, Vol 6, No 12, p 48-49, Dec 1969. 2 p 7 fig.

Descriptors: *Groundwater movement, *Mapping, *Flow nets, *Computer programs, Data processing, Forecasting, Water levels, Water table, Water level fluctuations, Computer models, Hydraulics.
Identifiers: Groundwater flow simulation.

In studying underground disposal systems for the Hanford nuclear plant, Battelle-Northwest developed a computer program which simulates the flow of groundwater. Flow patterns are displayed on a cathode-ray screen. Examples are given of the output of this program, showing the effect of adding additional points of withdrawal and injection to the original flow pattern. These changes are produced in a matter of seconds. (Knapp-USGS)
W70-04309

BEHAVIOR AND REACTIONS OF COPPER SULFATE IN AN IRRIGATION CANAL,
Battelle Memorial Inst., Richland, Wash; and Agricultural Research Service, Prosser, Wash. Crops Research Div.
J. L. Nelson, V. F. Bruns, C. C. Coutant, and B. L. Carlile.
Pesticides Monitoring Journal, Vol 3, No 3, p 186-189, Dec 1969. 4 p, 2 tab, 6 ref.

Descriptors: *Pesticides, *Algicides, *Irrigation canals, *Copper sulfate, Water chemistry, Sorption, Ion exchange, Pesticide residues, Pesticide kinetics, Persistence, Leaching, Infiltration.
Identifiers: Sunnyside (Wash).

Measurements of copper concentrations in water, in suspended sediment, and in bottom sediment of an irrigation canal after a copper sulfate treatment at 1 lb/cfs indicate that, after dissolution, much of the copper is sorbed by suspended sediment which gradually settles to the canal bottom. A large part of the copper in the deposited sediment is then slowly fed back into the canal water over a period of many hours. Buildup of copper in irrigated soils appears to be very minor. (Knapp-USGS)
W70-04315

THE SPREAD OF OIL SLICKS ON A CALM SEA,
Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
James A. Fay.
Available from Clearinghouse as AD-696 876, $3.00 in paper copy, $0.65 in microfiche. Massachusetts Institute of Technology Fluid Mechanics Laboratory Publication No 69-6, Aug 1969. 14 p, 3 fig, 2 ref.

Descriptors: *Oily water, *Oil-water interfaces, *Mathematical studies, Water pollution effects, Oil wastes, Water pollution sources, Hydraulics, Physical properties.
Identifiers: Oil-slick spreading.

The spread of oil slicks on water is analyzed mathematically and compared with field observations. Observations almost always show a rapid spread to a size which increases with volume of the spill, followed by a long period of no further growth. This behavior is ascribed to a sudden reduction of the net surface tension at a time when evaporation and dissolving of the lighter components of the oil has occurred. (Knapp-USGS)
W70-04321

ACID MINE DRAINAGE IN APPALACHIA.
Appalachian Regional Commission, Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-04328

THE INCIDENCE AND FORMATION OF MINE DRAINAGE POLLUTION IN APPALACHIA.
Corps of Engineers, Cincinnati, Ohio. Office of Appalachian Studies; and Bureau of Mines, Pittsburgh, Pa.
For primary bibliographic entry see Field 05G.
W70-04331

AUTOMATIC WATER SAMPLING PROPORTIONAL TO STREAMFLOW,
Geological Survey, Washington, D.C.; and Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
P. H. Carrigan, Jr., and W. F. Johnson.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D278-D282, 1969. 5 p, 5 fig, 2 ref.

Descriptors: *Water quality, *Sampling, *Monitoring, *Automatic control, Automation, Instrumentation, Radioisotopes, Radioactive wastes, Flowmeters, Waste dilution, Tracking techniques, Tracers, Dye releases.
Identifiers: Oak Ridge (Tenn), Automatic water sampling.

Low-level radioactive wastes from the Oak Ridge National Laboratory are released to the Clinch River, 2.3 miles downstream from Melton Hill Dam. Water samples proportional to river flow are composited at two stations, immediately and 8.6 miles downstream from the dam, to monitor radioactivity in the river. Sampling at the stations responds immediately to rapid changes in waste dilution owing to power releases at the dam. The sampling equipment frequently diverts aliquots of river water into a container, the duration of diversion being proportional to river flow. The flow is measured by the turbine flowmeter in the dam powerhouse and by a vane-deflection meter, developed in this study, at the respective stations. (Knapp-USGS)
W70-04336

EFFECT OF INDUSTRIAL EFFLUENT ON WATER QUALITY OF LITTLE SIX MILE CREEK NEAR JACKSONVILLE, FLORIDA,
Geological Survey, Ocala, Fla.
For primary bibliographic entry see Field 05C.
W70-04344

BRIEF TO THE INTERNATIONAL JOINT COMMISSION CONCERNING THE POLLUTION OF LAKES ERIE, ONTARIO AND THE INTERNATIONAL WATERS OF THE ST LAWRENCE RIVER,
Toronto Univ. (Ontario). Great Lakes Inst.
For primary bibliographic entry see Field 05G.
W70-04378

ANALOG COMPUTER MODELS FOR MOVEMENT OF NUCLIDES THROUGH ECOSYSTEMS,
Oak Ridge National Lab., Tenn. Health Physics Div.
Jerry S. Olson.
Radioecology, Vincent Schultz and Alfred W. Klement, Jr, editors, Reinhold Publishing Corp, N Y and The American Institute of Biological Sciences, Washington, D C, 1963. p 121-125. 9 fig, 9 ref.

Descriptors: *Analog models, *Analog computers, *Ecosystems, *Simulation analysis, *Computer models, Radioecology.
Identifiers: *Analog computer simulation, *Ecosystem modeling, Radionuclide movement.

Analog computers should fulfill an increasing need in the interpretation of radioecology data by providing a physical simulation of ecosystem processes. Such simulation capability offers a valuable analytic tool for resolving complicated ecological systems into their basic components. Construction of analog computer networks from ecosystem compartment models is accomplished through use of integrators, feedback potentiometers, function generators, servomultipliers, and diode-limiters. Diagrams of a simple ecosystem compartment model and its analog computer counterpart demonstrate the conversion technique. The analog computer models are as effective with nonlinear ecosystem models as they are with highly simplified linear models, thus they have advantages over other simulation tools. Analog models have been used to study transfer of carbon and radioactive carbon-14 in the ecosystem, and the same methodology can be extended to produce a variety of models for studying the transfer of fission products and mineral nutrients through ecosystems. (See Vol. 2, No. 19, Field 5C, W69-07863). (Huff-Wisconsin)
W70-04380

THE GREAT AND DIRTY LAKES,
For primary bibliographic entry see Field 05G.
W70-04430

ROSTHERNE MERE, ENGLAND, A FURTHER INSTANCE OF GUANOTROPHY,
Liverpool Univ. (England). Dept. of Zoology.
Ralph O. Brinkhurst, and Brenda Walsh.
Journal Fisheries Research Board of Canada, Vol 24, No 6, p 1299-1313, 1967. 4 fig, 1 tab, 24 ref, appendix.

Descriptors: *Water pollution sources, *Birds, Eutrophication, Benthic fauna, Sediments, Copepods, Organic matter, Pollutant identification, Hydrogen sulfide, Sampling, Chemical analysis, Nitrates, Phosphates, Temperature, Oxygen, Depth, Physicochemical properties, Tubificids, Ammonia, Diptera, Surface waters, Phytoplankton, Cyanophyta.
Identifiers: *Rostherne Mere (England), *Guanotrophy, Feces, Chironomidae, Chaoborus, Morphometric measurements, Phragmites, Typha, Carex, Polygonum, Nuphar, Nymphaea, Valvata, Micropsectra, Lundstroemia, Potamopyrgus, Glyptotendipes, Caenis, Ostracods, Limnodrius, Rhodomonas, Asterionella, Stephanodiscus, Limnodrilus, Stylodrilus, Microtendipes, Polypedilum, Aulodrilus, Helobdella, Glossiphonia, Pisidium, Sialis, Asellus, Potamothrix, Ilyodrilus.

Rostherne Mere, Cheshire, England, is a small lake with a maximum depth of about 30 meters. It is a normal dimictic eutrophic lake with a diverse benthic fauna, but the sediment in the deepest part is permanently deoxygenated and devoid of organisms other than copepods, probably in a dormant state. There is no dense layer of salt near the bottom and ammonia levels detected were not exceptionally high. The history of land-use around Rostherne Mere is not unique, and the human population is very small. The village received a piped water supply at the beginning of the century, but only sullage water reaches Rostherne Brook; three septic tanks drain into the mere, but their contribution of nutrients is negligible. Persistence of deoxygenated conditions in the sediments at the deepest part of Rostherne Mere and the associated presence of hydrogen sulfide render these sediments uninhabitable. In the absence of any significant organic pollution from human sources, this condition is attributed to deposition of feces from the very large bird population on the lake, both resident and transitory, especially the blackhead gulls (Larus ridibundus). (Jones-Wisconsin)
W70-04449

STUDIES ON SOME INLAND WATERS OF THE GALAPAGOS,
Wisconsin Univ., Milwaukee. Center for Great Lake Studies.
Richard Howmiller.
Ecology, Vol 50, No 1, p 72-80, 1969. 7 fig, 5 tab, 30 ref. NSF Grants GB 6870 and GB 6871.

Descriptors: *Saline lakes, *Water pollution sources, Birds, Oxygen, Nutrients, Photosynthesis, Chlorophyll, Shrimp, Fish, Lakes, Salinity.
Identifiers: *Guano, *Glapagos Islands, Ecuador, Corixids, Tanaid shrimp, Anostracan shrimp, Genovesa Island, Isabella Island, Guanotrophy.

Transparency, temperature, oxygen content, phosphorus, nitrite, nitrate, and hydrogen sulfide, pH value, salinity, plant pigments, and chlorophyll were determined in two large hypersaline lakes and three small ponds of lesser salt concentration in the Galapagos Islands. One of the lakes--Arcturus--is enriched in nutrients and organic matter by bird manure and presents an example of 'guanotrophy.' Another lake--Tagus Crater--has a rock salt bottom. Both lakes lack fish and their fauna is dominated by corixids and tanaid or anostracan shrimps. The ponds, in spite of their minute size (about 1/4 acre) harbor several species of fish. The study provides a transect-like picture of the influence of salinity and excessive content or organic fertilizer on physico-chemical features of water and survival of life forms. (Wilde-Wisconsin)
W70-04453

EFFECTS OF DAM CONSTRUCTION ON TEMPERATURES OF COLUMBIA RIVER,
Battelle-Northwest, Richland, Wash.
R. J. Jaske, and J. B. Goebel.
Journal American Waterworks Association, Vol. 59, p. 935-942, August 1967. 4 fig., 4 tab., 5 ref.

Descriptors: *Columbia River, *Thermal pollution, Data collections, Grand Coulee Dam, Ecology, *Temperature, Statistical models, Environmental effects, Dams, Dam construction, Reservoirs, Impoundments.
Identifiers: *Environmental model, Hybrid analog-digital computer, Temperature prediction, Lake Roosevelt, Rock Island Dam, Rocky Reach Dam, Travel time.

To evaluate the results of the program to reduce the temperature of the Columbia River to minimize the impact of powerplant operations, a system of data collection points was installed. The resulting data have been used to develop an environmental model, least square functional, which, with the use of a hybrid analog-digital computer, is capable of predicting temperature and associated water quality variables. Resulting data on stream and reservoir temperatures are presented. It was found that the erection of low-head reservoirs on the main stem of the Columbia River has not produced significant change in the average temperature of the river. The erection of Grand Coulee Dam on Lake Roosevelt

has resulted in a 30 day delay in the transport of water through the reservoir system. The erection of dams and reservoirs decreases expected variance in the water temperatures. The ecological effect of Columbia River impoundments is not comparable in size to large storage projects. (Rietveld-Vanderbilt)
W70-04474

A MATHEMATICAL MODEL OF STREAM TEMPERATURE,
Johns Hopkins Univ., Baltimore, Md.
D. W. Duttweiler.
Available from University Microfilms, Ann Arbor, Michigan. Ph. D. Thesis, The Johns Hopkins University, Baltimore, Md., 1963. 140 p, 23 fig., 15 tab., 54 ref.

Descriptors: *Water temperature, *Mathematical models, Air temperature, Climatology, Evaporation, *Heat balance, Heat transfer, Thermal pollution, Energy budget, Thermal radiation, Specific heat, Thermal properties, Convection, Pollutants, Heat flow, Thermal powerplants, Solar radiation, Electromagnetic waves, Streams, Lakes, Environmental effects, *Temperature.
Identifiers: Heat conductivity, Equilibrium temperature.

A mathematical model of stream temperature as a function of time and downstream distance was derived based on the approximately linear response of the stream to a 'temperature input function' T sub epsilon (t). The actual non-linear properties of the mechanism were demonstrated, and the necessary linear approximations in certain of the heat budget terms were developed. Independent expressions were given for T sub epsilon (t) and the exchange coefficient lambda, which permit their calculation from observations of climatological variables. The model was given a limited test to confirm the basic concept and verify expressions for T sub epsilon (t) and lambda. The expressions were tentatively shown to be satisfactory. The model was used to predict 19 hourly temperatures in a small stream, using one method, and 13 monthly average temperatures for a large lake, using another method, with moderate accuracy. The latter method was based solely on observed climatological variables. The model was shown to be useful in estimating downstream temperatures below a waste heat discharge and below the release of stored water in low-flow augmentation. (Novotny-Vanderbilt)
W70-04487

DISTRIBUTION OF NITRATES AND OTHER WATER POLLUTANTS UNDER FIELDS AND CORRALS IN THE MIDDLE SOUTH PLATTE VALLEY OF COLORADO,
Agricultural Research Service, Fort Collins, Colo. Northern Plains Branch; and Colorado Agricultural Experiment Station, Fort Collins.
B. A. Stewart, F. G. Viets, Jr., G. L. Hutchinson, W. D. Kemper, and F. E. Clark.
U S Department of Agriculture, Agricultural Research Service, ARS 41-134, December 1967, 206 p. 31 fig, 25 tab, 13 ref.

Descriptors: *Nitrates, *Ammonia, *Water pollution sources, *Cores, Fields, Plants, Alfalfa, Cereal crops, Irrigated land, Colorado, Groundwater, Percolation.
Identifiers: Native grasses, Feedlots, Corrals, South Platte Valley (Colo).

Cores representing nonirrigated fields in native grass, cultivated nonirrigated fields, irrigated fields in alfalfa, irrigated fields in crops other than alfalfa, and corrals were obtained from northeastern Colorado during 1966. Cultivated nonirrigated fields usually contained small accumulations of nitrate below the root zone. Native grass fields, ordinarily, did not show nitrate accumulation in core profiles. Significant quantities of nitrate were found in most cores from irrigated fields with row crops or cereal grains. Alternately, cores from irrigated alfalfa fields generally contained insignificant amounts of nitrate. Amounts of nitrogen as nitrate found under corrals were extremely varied, ranging from almost none to more than 5000 pounds/acre in a 20-foot profile. Evidence disclosed that denitrification was occurring under feedlots, even at several feet below the surface, consequently, much of nitrate under feedlots will probably never reach the water table. Water samples beneath several corrals contained large amounts of organic carbon and ammonia and possessed offensive odor. Bacterial counts under corrals were considerably higher than under other areas, especially at lower depths. These findings indicate some pollution of groundwater by deep percolation is occurring from corrals, but more studies are required before significance and magnitude of this pollution can be assessed. (Keeney-Wisconsin)
W70-04488

AGRICULTURAL DRAINAGE AND EUTROPHICATION,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 05C.
W70-04504

NUTRIENT OUTPUT FROM MANAGED FORESTS,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 05C.
W70-04505

5C. Effects of Pollution

VERTICAL AND HORIZONTAL DISTRIBUTION OF PHYTOPLANKTON IN QUABBIN RESERVOIR,
Massachusetts Univ., Amherst. Water Resources Research Center.
Paul A. Erickson, and John T. Reynolds.
Available from the Clearinghouse as PB-189 765, $3.00 in paper copy, $0.65 in microfiche. Interim Report, Massachusetts Water Resources Research Center, Publication No 9, Dec 1969. 44 p, 19 fig, 4 append. OWRR Project B-006-MASS.

Descriptors: *Phytoplankton, *Eutrophication, Reservoirs, Planning.
Identifiers: Microbial population patterns.

Phytoplanktonic data collected incidentally to the aims of the studies on eutrophication in Quabbin Reservoir are a significant addition to the knowledge of the characteristic phytoplankton in this major Massachusetts' Reservoir. Four distinct areas are defined in terms of the horizontal and vertical distribution of three types of phytoplankton, and these areas seem to correspond to subdivisions of the reservoir which can be made on the basis of other physical and chemical data. While such areas may or may not prove to be of general ecological significance in the light of more exhaustive studies, even preliminary evidence of consistent phytoplanktonic differences throughout the reservoir might help to define the aims and direct the efforts of any future study of eutrophication in Quabbin. Information on such differences is particularly important today because diversions of water into Quabbin from polluted sources such as the Connecticut River are being contemplated, and because the basis for a measurement of the efficiency and effect of treatment plants constructed as part of those diversions will be a knowledge of microbial population patterns in Quabbin prior to the mixing.
W70-04046

STUDIES ON THE POPULATION DYNAMICS AND PHYSIOLOGICAL ECOLOGY OF FOUR SPECIES OF FRESH-WATER ISOPODS,
Illinois Univ., Urbana. Water Resources Center.
Arthur J. Seidenberg.
Available from the Clearinghouse as PB-189 792, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Illinois Water Resources Center, Research Report No. 27, Jan 1970. 69 p, 6 tab, 24 fig, 85 ref. OWRR Project A-018-ILL.

Descriptors: Isopods, Fish parasities.
Identifiers: Parasite, Asellus, Lirceus, Acanthocephalus, Thermal tolerance, Pollution fauna, Population dynamics, Host-parasite relationships.

The comparative biology of four species of freshwater isopods has been investigated. Isopods are known to be part of the 'pollution fauna' that can inhabit badly polluted areas. The species studies inhabit a temporary pond, a drainage ditch, a small permanent stream, and the subterranean water, all relatively undisturbed areas. Their tolerance to high temperature and survival out of water, growth rates, and duration of embryonic development have been investigated and differences among the species have been suggested to be adaptive for the particular population under study. The general population biology of these species was studies including their life cycles and general ecology. The 'basic biology' reported for these organisms will allow investigators to assess more clearly the effects of man-made disturbances on these aquatic organisms. One of the species studied was found to be an intermediate host of a worm that is a fish parasite. The host-parasite relationships between the worm and the isopod were also investigated. Fish acquire the parasite after eating the isopod. The isopod population was found to be very heavily infected (up to 65%) with these worm larvae. The larvae cause the isopods to lose weight and produce a mortality in heavily infected isopods. This means a drastic reduction in the amount of isopod food available to fish.
W70-04073

APPLICATION OF RADIOISOTOPE TECHNIQUES TO A CRITICAL WATER RESOURCES PROBLEM AREA - NAMELY NUTRITIONAL POLLUTION,
Oklahoma Univ., Norman. Dept. of Civil Engineering and Sanitary Science; and Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05A.
W70-04074

CHEMISTRY OF NITROGEN AND PHOSPHORUS IN WATER,
P. L. McCarty.
Journal American Water Works Association, Vol 62, No 2, p 127-140, Feb 1970. 14 p, 6 fig, 8 tab, 64 ref.

Descriptors: *Nutrients, *Eutrophication, *Water quality control, *Nitrogen compounds, *Phosphorus compounds, Algae, Nutrient requirements, Productivity, Essential nutrients, Water quality, Water chemistry, Cycling nutrients.
Identifiers: Nitrogen requirements (Algae), Phosphorus requirements (Algae), Nutrient chemistry (Aquatic).

Of the major elements essential to algal growth, nitrogen and phosphorus are the ones most likely to be of critically limiting availability in natural waters. Because they therefore represent promising weak links in algal life cycles, their chemical states and behavior in water are examined to see how water treatment might benefit. Large supplies of nitrogen and phosphorus are present in many bodies of water either in the sediments, the atmosphere above, or in the form of dissolved gas. These forms may be available for the growth of algae and other aquatic plants, but the rates at which they may become available is slow. These rates are important, however, as they tend to control the amount of vegetative growth which can be supported. Soluble nitrogen and phosphorus contained in the effluents from waste treatment plants, on the other hand, are in a readily available form. If discharged to natural bodies of water, they can stimulate growth far in excess of that which would occur naturally. (Knapp-USGS)
W70-04080

DEFORMATION OF DEVELOPING EMBRYOS OF SEA URCHINS WITH CHANGES IN THE IONIC ENVIRONMENT,
McGill Univ., Montreal (Quebec). Dept. of Zoology.
N. Wolfson.
Canadian Journal of Zoology, Vol 47, No 6, p 1363-1365, 1969. 4 fig, 16 ref.

Descriptors: *Deformation, *Environmental effects, Embryonic growth stage, Sodium chloride, Calcium.
Identifiers: *Paracentrotus lividus, *Embryonic development, *Abnormal development, Ionic environmental changes, Fertilization membranes, Blastulae, Speudopods, Ameboid transformations.

Embryos of Paracentrotus lividus, deprived of their fertilization membranes and exposed for periods of 10-120 min to cold buffered isotonic NaCl at various cleavage stages, will often exhibit pseudopodial extensions of the external surface of blastomeres still in embryonic association. Similarly treated embryos allowed to develop for 1-2 days in seawater will often fuse to produce large monsters with continuous blastocoels. Photographs of living embryos displaying blastomeric pseudopods and multiembryonic fusion are presented. The exposure of embryos to artificial saline may promote losses of calcium, of hyaline layer, and perhaps of other superficial components, some of which are reversible losses and others not, after return to seawater. (Katz and Sjolseth-Washington)
W70-04144

A CHEMICAL SELECTIVELY LETHAL TO SQUAWFISH (PTYCHOCHEILUS OREGONENSIS AND P. UMPQUAE),
Idaho Univ., Moscow.
Craig MacPhee, and Richard Ruelle.
Contract with the Columbia River Fishery, Development Program, Bu. of Commercial Fisheries, U.S. Fish and Wildlife Service. Transactions of the American Fisheries Society, Vol 98, No 4, p 676-684, Oct 1969. 6 tab, 3 fig, 9 ref.

Descriptors: *Fish control agents, *Bioassay, *Resistance, *Selectivity, Fish management, Toxicity, Salmonids, Mortality, Public health.
Identifiers: *Squawfish, Ptychocheilus oregonensis, Ptychochelus umpqua, *1-1'-methlenedi-2-naphthol, *Water temperature effects, *Tolerance.

A piscicide, 1,1'-methylenedi-2-naphthol, is lethal to Ptychocheilus oregonensis and P. umpqua at concentrations of 3 to 100 times more toxic to squawfish than to salmonids. Selectivity of the chemical varies with the tolerances of the species and its potency varies positively with concentration and temperature. For a thermal range of 18.3 to 10.0 C, the minimum LC sub 100 is .006 to 0.014 ppm for P. oregonensis and 0101 to 0103 ppm for P. umpquae. Within these ranges the mean survival time varies from 6 to 31 hr for P. oregonensis and 6 to 20 hr for P. umpquae. In 96 -hour assays at similar temperature, the maximum LC sub 0 is about 0.3 ppm for Salvelinus fontinalis, 0.1 ppm for Oncorhynchus tshawytscha, and from 0.6 to 1.3 ppm for O. kisutch and Salmo gairdneri depending on the water temperature. One domestic sheep and two ducks showed no ill effects when forced to drink water containing 10 ppm of the chemical for 1 week. A field application in a small lagoon containing several species of fish killed only P. oregonensis. (Katz and Sjolseth-Washington)
W70-04145

OXYGEN CONSUMPTION OF ENDRIN-SUSCEPTIBLE AND ENDRIN-RESISTANT GAMBUSIA DURING SUBLETHAL AND ACUTE ENDRIN EXPOSURE,
Mississippi State Univ., State College.
Charm R. McIngvale, Larry Ludke, and Denzel E. Ferguson.
Journal of the Mississippi Academy of Sciences, Vol XIV, 1968. Reprint, 6 p, 3 fig, 6 ref. US Public Health Service Grants ES-00086 and UI-00348.

Descriptors: *Endrin, *Respiration, Oxygen requirements, Resistance, Chlorinated hydrocarbon pesticides.
Identifiers: *Oxygen consumption, Mosquitofish, Gambusia affinis, Endrin-resistance, Susceptible mosquitofish.

The rate of oxygen consumption of endrin-resistant mosquitofish, Gambusia affinis, was significantly lower (26%) than that of a susceptible strain. Susceptible individuals showed an increase in rate of oxygen uptake with the onsent of poisoning symptoms, followed by a decrease prior to death. Resistant fish exhibited no consistent change in rate of oxygen consumption in endrin. When susceptible fish were subjected for 3 hours to 0.1, 2.0, and 10.0 ppb endrin, none died and oxygen uptake fell below the control group, but only the 0.1 ppb data differed significantly. At higher concentrations of exposure (20 and 75 ppb) the total oxygen consumed by susceptible fish decreased significantly from the control group. Total oxygen consumed over a 3 hour test period and average rate of uptake of resistant mosquitofish did not differ significantly between the control and treated groups. (Katz and Sjolseth-Washington)
W70-04146

RESPONSE OF THE GLOBIFEROUS PEDICELLARIAE TO INORGANIC SALTS IN THREE REGULAR ECHINOIDS,
Newcastle-upon-Tyne Univ. (England). Dove Marine Lab.
Fu-Shiang Chia.
Ophelia, Vol 6, p 203-210, July 1969. 3 fig, 20 ref.

Descriptors: *Inorganic compounds, *Copper sulfate, Potassium compounds, Venoms, Mode of action.
Identifiers: *Pedicellariae, *Echinodermata, *Inorganic salts, *Activation, *Avoidance responses, Echinus esculentus, Zinc salts, Potassium chloride, Potassium sulfate, Psammechinus miliaris, Strongylocentrotus droebachiensis, Response, Starfishes.

The globiferous pedicellariae of Echinus esculentus (L.), Psammechinus miliaris (Gmelin) and Strongylocentrotus droebachiensis (O.F.M.) may be activated by a number of inorganic salts such as ZnCl2, ZnSO4, CuCl2, CuSO4, KCl, and K2SO4, even at great dilutions; the reaction is similar to that evoked by predatory starfishes. The discharge of venom may also be induced by potassium salts both in situ as well as with isolated pedicellariae. In all three species, the venom discharges through the fang-like tooth via a small opening located in a subterminal position. The venom apparatus functions as a hypodermic syringe which injects the venom directly into the wound. After discharge, the pedicellaria breaks away from the test at the base of the stalk (autotomy). In Psammechinus, it takes 25 days to regenerate a new and functional pedicellaria. (Katz and Sjolseth-Washington)
W70-04147

PESTICIDE TOLERANCES OF SELECTED FRESHWATER INVERTEBRATES,
Mississippi State Univ., State College.
Syed M. Naqvi, and Denzel E. Ferguson.
Journal of the Mississippi Academy of Sciences, Vol XIV, 1968. Reprint, 7 p, 4 tab, 6 ref. US Public Health Service Grants ES-00086 and UI-00348.

Descriptors: *Chlorinated hydrocarbon pesticides, *Organophosphorus pesticides, *Pesticide toxicity, *Bioassays, *Copepods, DDT, Endrin, Aldrin, Dieldrin, Mortality, Snails, Clams, Tubificids, Resistance, Food pyramids.
Identifiers: *Physa gyrina, *Tolerances, Chlordane, Lindane, Malathion, Phosdrin, Toxaphene, Parathion, Eupera singleyi, Tubifex tubifex, Belzoni (Miss), State College (Miss).

In a 48-hr exposure to various concentrations of nine insecticides, six species of cyclopoid copepods from a pesticide contaminated ditch near Belzoni, Mississippi, displayed higher tolerances than did the same species from areas of minimal pesticide contamination near State College, Mississippi. Similarly, a clam, Eupera singleyi, and a snail, Physa gyrina, from the Belzoni locality had higher tolerances to endrin and toxaphene than the same species from near State College. Extremely high concentrations of 20 insecticides failed to kill the worm Tubifex tubifex, from Belzoni in 72-hr tests. The potential effect of increased tolerances in these invertebrate species is to increase the amount of pesticide residues available to higher trophic levels. (Katz and Sjolseth-Washington)
W70-04149

A LIMNOLOGICAL STUDY OF THE LOWER FARMINGTON RIVER WITH SPECIAL REFERENCE TO THE ABILITY OF THE RIVER TO SUPPORT AMERICAN SHAD,
Connecticut Univ., Storrs. Dept. of Fisheries.
Walter R. Whiteworth, and David H. Bennett.
Institue of Water Resources, University of Connecticut, Rept No 9, Feb 1970. 57 p, 29 tab, 7 fig, 26 ref. Supported in part by the Connecticut Research Commission (Grant No RSA 66-5).

Descriptors: *Limnology, *Bioassay, *Water pollution effects, *Effluents, Aquatic environment, Biological properties, Chemical properties, Biochemical oxygen demand, Plankton, Zooplankton, Sampling, Hydrogen ion concentration, Community development, Metabolism, Ecological distribution, Water temperature, Heavy metals, Oxygen requirements, Industrial waste.
Identifiers: *Alosa sapidissima, *Lead, American shad, Farmington River, Connecticut, Connecticut River, Colonization, Community metabolism, Bottom fauna.

Fish, plankton, bottom fauna, and water were sampled in the Lower Farmington River as part of a comprehensive limnological survey. Water temperature, B.O.D., rate of slide colonization tests, estimates of community metabolism and effects of effluents were studied. Laboratory and field bioassays using various fish were conducted with effluents common to the Farmington River. The effects of fluctuating DO levels on hatching of shad eggs were studied. Shad were transferred into the River and from the data collected the authors conclude that the River is capable of supporting a significant shad run, and should not be measurably affected by the effluent discharge. A set of 5 recommendations concerned with building the shad runs is presented. (Katz and Sjolseth-Washington)
W70-04150

EFFECT OF FEEDING AND OF DDT ON THE ACTIVITY OF HEPATIC GLUCOSE 6-PHOSPHATE DEHYDROGENASE IN TWO SALMONIDS,
Bureau of Sport Fisheries and Wildlife, Columbia, Mo. Fish-Pesticide Research Lab.
Donald R. Buhler, and P. Benville.
Journal Fisheries Research Board of Canada, Vol 26, No 12, p 3209-3216, 1969. 5 tab, 27 ref.

Descriptors: *DDT, *Enzyme, *Fish physiology, Rainbow trout, Fish diets, Chlorinated hydrocarbon pesticides, Pesticide toxicity.
Identifiers: *Insulin, *Hepatic enzymes, Enzyme activity, Coho salmon, Starvation, Liver size.

The specific activity of liver glucose 6-phosphate dehydrogenase in yearling rainbow trout remained unchanged when the fish were starved for periods as long as 8 weeks and when starved animals were fed diets of various compositions. Injection of insulin concurrently with refeeding also failed to alter the specific activity of the enzyme in trout. Ingestion of the pesticide DDT by juvenile coho salmon or adult rainbow trout also had no effect on the specific activity of liver glucose 6-P dehydrogenase and DDT failed to inhibit the rainbow trout enzyme in vitro. These results also differ considerably from those found in higher animals. These results suggest that the glucose 6-P

dehydrogenase enzyme in teleosts may be under a different type of regulatory control from that found in mammals. (Sjolseth-Washington)
W70-04151

ACUTE TOXICITIES OF INSECTICIDES TO MARINE DECAPOD CRUSTACEANS,
Bureau of Sport Fisheries and Wildlife, Highland, N.J. Fish-Pesticide Research Lab.
Ronald Eisler.
Crustaceana, Vol 16, Part 3, p 302-310, 1969. 4 fig, 3 tab, 20 ref.

Descriptors: *Bioassay, *DDT, *Pesticide toxicity, Chlorinated hydrocarbon pesticides, Organophosphorus pesticides, Endrin, Aldrin, Heptachlor, Dieldrin, Salinity, Water temperature, Resistance, *Crustaceans.
Identifiers: *Malathion, *Methyl parathion, DDVP, Palaemonetes vulgaris, Crangon septemspinosa, Pagurus longicarpus, LC 50.

The concentrations of seven chlorinated hydrocarbon pesticides (aldrin, dieldrin, endrin, heptachlor, lindane, methoxychlor, and DDT) and 5 organophosphorus pesticides (DDVP, Delnav, phosdrin, malathion, and methyl parathion) that kill 50 percent of 3 decapod crustaceans (grass shrimp, sand shrimps and hermit crabs) during a 96 hour period were determined at different temperatures and salinities. Sand shrimp are the most sensitive to all insecticides. Of the chlorinated hydrocarbons, heptachlor is the least toxic to all species (96 hr, LC-50 range of 8 ug/l for sand shrimp to 440 ug/l for grass shrimp) and DDT about the most toxic (96 hr, LC-50 range of 0.6 ug/l for sand shrimp to 6 ug/l for hermit crabs). Of the organophosphorus pesticides, methyl parathion is the most toxic (96 hr, LC-50 range of 2-7 ug/l) and Delnav or malathion the least toxic (96 hr, LC-50 range of 33-285 ug/l). Temperature and salinity profoundly affect the mortality. Mortality among shrimp was least at 10 deg and highest at 30 deg C and intermediate at intermediate temperatures for all insecticides. The effect of salinity varied among the insecticides. (Sjolseth-Washington)
W70-04152

TOXICITY OF PESTICIDE INGREDIENTS TO SOME FRESH WATER ORGANISMS (JAPANESE),
Agricultural Chemical Inspection Station, Tokyo (Japan).
Yasushiro Nishuichi, and Yasushi Hashimoto.
English summary - Tables in English. Scientific Pest Control, BOTYU-KAGAKU, Vol 32, I. The Institue of Insect Control, Kyoto University, p 5-11, Feb 1967. 5 tab, 3 fig, 7 ref.

Descriptors: *Pesticide toxicity, *Bioassay, *Organophosphorus pesticides, *Chlorinated hydrocarbon pesticides, *Carbamate pesticides, *Solvents, Fungicides, Herbicides, Lethal limit.
Identifiers: *Organomercuric compounds, *Organotin compounds, *Organosulfuric fungicides, Cyprinus carpio, Daphnia, Oryzias latipes, Median tolerance limits, Susceptibility.

Toxicities of seventy-six kinds of pesticide ingredients to three kinds of fresh water fishes and two kinds of fresh water daphnids were evaluated. The test organisms are Cyprinus carpio, C. auratux, Oryzias latipes, and Moina macrocopa. In general, organophosphorus compounds are less toxic to fresh water fishes, while these are remarkably toxic to daphnids. Chlorinated hydrocarbon compounds are remarkably toxic to the fishes, but not so toxic to daphnids. An exception is Thiodan, which is remarkably toxic to both fishes and daphnids. Carbamate insecticides are non-toxic to fishes, but specifically toxic to daphnids. Organomercuric and organotin compounds are remarkably toxic to both fishes and daphnids. Organoarsenic fungicides are low toxicity to both fishes and daphnids. Organosulfuric and the other synthetized fungicides tested are highly toxic to fishes, but not so toxic to daphnids. Herbicides are generally non-toxic to both fishes and daphnids, but some of them are toxic. Fresh water fishes and daphnids are clearly different in susceptibility to pesticides. A considerably high correlation is recognized between the susceptibility of Cyprinus carpio and C. auratus, and between Daphnia pulex and Moina macrocopa. Orizias latipes is selectively susceptible to some kinds of pesticide ingredients. (Sjolseth and Katz-Washington)
W70-04153

LETHAL EFFECTS OF 1888 CHEMICALS UPON FOUR SPECIES OF FISH FROM WESTERN NORTH AMERICA,
Idaho Univ., Moscow. Coll. of Forestry-Wildlife and Range Sciences.
Craig MacPhee, and Richard Ruelle.
Contract with the Columbia River Fishery Development Program, Bu of Comm Fish, US Fish and Wildlife Service. Forest, Wildlife and Range Experiment Station, Bull No 3, Univ of Idaho, College of Forestry - Wildlife and Range Sciences, Nov 1969. 112 p, 4 tab, 2 ref.

Descriptors: *Bioassay, Chinook salmon, Rainbow trout, *Lethal limit, Mortality, *Toxicity, Pollutants, *Toxins, Wastes.
Identifiers: Equilibrium loss, Coho salmon, Steelhead, Northern squawfish.

A piscicide screening program was conducted with 1,888 different chemicals mostly at concentrations of 10 ppm. The times at which fish lost their equilibrium and died are given for 2,552 separate 24-hour assays. The species tested were the northern squawfish (Ptychocheilus oregonensis) chinook salmon (Oncorhynchus tshawytscha), coho salmon (Oncorhynchus kisutch) and steelhead (Salmo gairdneri). (Sjolseth and Katz-Washington)
W70-04154

EFFECTS OF THE INSECTICIDE SEVIN ON SURVIVAL AND GROWTH OF THE COCKLE CLAM CLINOCARDIUM NUTALLI,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
Jerry A. Butler, Raymond E. Millemann, and Nelson E. Stewart.
Supported by Public Health Service Research Grant CC-00303 from the National Communicable Disease Center, Atlanta, Ga. Journal Fisheries Research Board of Canada, Vol 25, No 8, p 1621-1635, 1968. 6 tab, 2 fig, 22 ref.

Descriptors: *Carbamate pesticides, *Growth rates, *Bioassay, Pesticide toxicity, Clams, Animal control, Pesticide residues, Mortality, Water temperature, Pesticide removal.
Identifiers: *Sevin, *1-naphthol, *Food consumption, Food conversion efficiency, Survival, Clinocardium nutalli.

Experiments are reported on the effects of the insecticide Sevin and its hydrolytic product, 1-naphthol, on the survival, growth, and food consumption of larval and juvenile cockle clams (Clinocardium nuttalli). Toxicant concentrations ranged from 0.1 to 10.0 mg/liter. Larvae exposed to Sevin concentrations of 0.8 mg/liter were dead by day 7 of the test, and the growth of those exposed to 0.4 mg/liter was reduced by 15%. Sevin was less toxic than 1-naphthol to juvenile clams, the respective 96-hr TL's (median tolerance limits) being 3.75 and 2.70 mg/liter. The growth of juvenile clams was reduced more by 1-naphthol than by Sevin. The food consumption of juvenile clams exposed to 1.6 mg/liter of Sevin was markedly reduced and their food conversion efficiency was impaired. Adult clams exposed to Sevin concentrated the toxicant in their tissues; maximum concentrations were reached after 12 hr of exposure. Clams exposed at 11 C concentrated more toxicant than those exposed at 20 C. Tissue concentrations of toxicant decreased sharply after the clams had been in clean sea water for 12 hr. (Sjolseth and Katz-Washington)
W70-04155

THE CALCULATION OF THE ACUTE TOXICITY OF MIXTURES OF POISONS TO RAINBOW TROUT,
Water Pollution Research Lab., Stevenage (England).
For primary bibliographic entry see Field 05A.
W70-04156

BIOLOGICAL EFFECTS OF THERMAL DISCHARGES: ANNUAL PROGRESS REPORT FOR 1968,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
W. L. Templeton, C. D. Becker, J. D. Berlin, C. C. Coutant, and J. M. Dean.
Reprinted from Pacific Northwest Laboratory Annual Report for 1968 to USAEC Division of Biology and Medicine, Volume I: Life Sciences. USAEC Research and Development Report No BNWL-1050, Dec 1969. 49 p.

Descriptors: *Thermal pollution, *Thermal stress, Water pollution effects, *Salmoids, *Columbia River, *Fish physiology, Fishkill, Nuclear reactors, Water temperature, Fish behavior.
Identifiers: Thermal resistance, Thermal shock, Thermal tolerance.

This is the second annual report issued by Battelle-Northwest's Aquatic Ecology Section which deals exclusively with research to determine the effects of thermal additions to aquatic environments. The individual papers, all separately abstracted, include the following titles: Responses of Salmonid Fishes to Acute Thermal Shock, Passage of Downstream Migrants, Chinook Salmon Spawning Ner Hanford - 1968, Gull Predation in a Reactor Discharge Plume, Effects of Chronic Variable Water Temperature on Survival and Growth of Young Chinook Salmon, Behavior of Sonic-Tagged Chinook Salmon and Steelhead Trout Migrating Past Hanford Thermal Discharges, The Food and Feeding of Juvenile Chinook Salmon in the Columbia River at Hanford, Columnaris Exposure and Antibody Development Among Upstream Migrant Salmonids, Oral Immunization of Juvenile Coho Salmon Against Chondrococcus Columnaris, The Response of Juvenile Salmonids to Acute Thermal Shock, and Alterations in Hepatocyte Function of Thermally Acclimated Rainbow Trout (Salmo Grirdneri). (See also W70-04158 thru W70-04163).
W70-04157

RESPONSES OF SALMONID FISHES TO ACUTE THERMAL SHOCK,
Battelle-Northwest, Richland, Wash.
C. C. Coutant.
In Biological Effects of Thermal Discharges: Annual Progress Report for 1968, p 1-8, Dec 1969. 6 fig, 2 tab, 1 ref.

Descriptors: *Thermal pollution, *Thermal stress, *Fishkill, Rainbow trout, Chinook salmon, Salmonids, Equilibrium, Water temperature, Mortality, Resistance, Fish predation, Fish behavior, Columbia River, Nuclear reactors.
Identifiers: *Thermal shock, *Thermal resistance, Coho salmon, Hanford Atomic Works.

Chinook salmon, coho salmon, and rainbow trout were subjected to acute thermal shock in order to determine any relationships between times to equilibrium loss and death of fish populations. There is a variation with test temperature in the relationship between times to equilibrium loss and death in juvenile chinook salmon and rainbow trout. Chinook salmon and rainbow trout undergo increased predation at sublethal exposures to lethal temperature. Equilibrium loss due to thermal shock is not reversible at all lethal temperatures, for the studies show large delayed mortality of rainbow trout 24 hours after exposure to 27-30 deg C. Above 30 deg C equilibrium loss is reversible. Thermal resistance differences between juvenile and large coho and chinook salmon in addition to species differences were found. Above 28 deg C juvenile chinook are most sensitive, then juvenile

coho, adult coho and adult chinook and below 28 deg C it is adult coho, juvenile chinook and juvenile coho the least sensitive. (See W70-04157). (Sjolseth-Washington)
W70-04158

PASSAGE OF DOWNSTREAM MIGRANTS,
Battelle-Northwest, Richland, Wash.
C. C. Coutant, C. D. Becker, and E. F. Prentice.
Biological Effects of Thermal Discharges: Annual Progress Report for 1968, p 9-12, Dec 1969. 2 fig, 1 tab.

Descriptors: *Thermal pollution, *Thermal stress, *Acclimatization, Chinook salmon, Fishkill, Equilibrium, Water temperature, Columbia River, Mortality, Nuclear reactors.
Identifiers: *Thermal resistance, *Thermal shock, Hanford Atomic Works.

Juvenile chinook salmon were confined to live boxes which were drifted through reactor discharge plumes below Hanford on the Columbia River. No direct or 24 hour latent mortalities were induced during spring and summer. Shoreline areas affected by intragravel seepage of heated water reached lethal levels for chinook. In these area losses of test fish during mid-summer occurred. Most temperature rises did not exceed the ultimate incipient lethal level for the species. Emigrating juvenile chinook trapped in May following passage through the warmest part of the thermal discharge plume showed no mortality, equilibrium loss or 'gas bubble' disease. The authors feel that most emigrating juvenile salmon are successful in passing areas of maximum thermal change at Hanford. (See W70-04157). (Sjolseth-Washington)
W70-04159

EFFECTS OF CHRONIC VARIABLE WATER TEMPERATURES ON SURVIVAL AND GROWTH OF YOUNG CHINOOK SALMON,
Battelle-Northwest, Richland, Wash.
P. A. Olson, and R. E. Nakatani.
Biological Effects of Thermal Discharges: Annual Progress Report for 1968, p 17-20, Dec 1969. 1 fig, 1 tab.

Descriptors: *Fishkill, *Fish eggs, *Thermal pollution, *Growth rate, Chinook salmon, Columbia River, Spawning, Mortality, Thermal stress, Resistance, Nuclear reactors.
Identifiers: *Thermal resistance, Hanford Atomic Works.

Fertilized eggs from five pairs of chinook salmon were taken and exposed to six different temperature regimes following the Columbia River's seasonal pattern and expressing different heating rates on a cumulative weekly basis during early development. A constant temperature increment above base river temperatures of 2.5 deg C caused slightly increased egg mortalities. An eventual 5 deg C increment above base river temperatures produced no increased mortality in the majority of spawns when added by 20 cumulative weekly increments of 0.25 deg C, although increased mortality occurred if this 5 deg C rise was done at 0.5 deg C for 10 weeks. It was noticed that warmer water condtions resulted in increased growth rates. (See W70-04157). (Sjolseth-Washington)
W70-04160

BEHAVIOR OF SONIC-TAGGED CHINOOK SALMON AND STEELHEAD TROUT MIGRATING PAST HANDFORD THERMAL DISCHARGES,
Battelle-Northwest, Richland, Wash.
C. C. Coutant.
Biological Effects of Thermal Discharges: Annual Progress Report for 1968, p 21-26, Dec 1969. 1 tab, 2 fig.

Descriptors: *Thermal pollution, *Fish behavior, *Fish migration, Chinook salmon, Rainbow trout, Columbia River, Nuclear reactors, Thermal stress, Water temperature, Distribution patterns, Tagging.
Identifiers: *Steelhead trout, *Sonic fish tags, Hanford Atomic Works, Migration rates.

Eighty-nine chinook salmon and 279 steelhead were marked with sonic tags to determine their pathways of spawning migrations as they move through the warm waters surrounding the Hanford facilities. The fish were found to migrate mainly along the shoreline, principally utilizing the left bank opposite the reactors during peak river temperatures. No statistical difference was found between migration rates of the two species or between rates along shorelines inside and outside the reactors' thermal influence. Average migration rates were studied and found to be distinctly nonuniform. The authors feel there is insufficient data available to identify the causes of anomalies in distribution and migration rate. (Sjolseth-Washington)
W70-04161

THE FOOD AND FEEDING OF JUVENILE CHINOOK SALMON IN THE COLUMBIA RIVER AT HANFORD,
Battelle-Northwest, Richland, Wash.
D. C. Becker.
Biological Effects of Thermal Discharges: Annual Progress Report for 1968, p 27-31, Dec 1969. 1 tab, 1 fig, 2 ref.

Descriptors: *Fish diets, *Aquatic insects, *Thermal pollution, Chinook salmon, Columbia River, Nuclear reactors, Water temperature.
Identifiers: *Feeding activity, *Fish stomach contents, Hanford Atomic Works, Terrestrial insects, Chironomids.

Stomach contents of 445 young chinook salmon taken near Hanford were examined. They fed primarily upon aquatic insects, mainly chironomids, and secondarily on terrestrial insects. No evidence was found to suggest that heated effluents discharged in midwater plumes and which rapidly mix with the colder river water adversely affects either insect production or feeding activity of fish. Food intake was restricted in a few shoreline areas receiving warm water via intragravel seepage. The author feels that thermal discharge to the river, when waters are below preferred levels during spring runoff, may actually benefit the fish. (Sjolseth-Washington)
W70-04162

THE RESPONSE OF JUVENILE SALMONIDS TO ACUTE THERMAL SHOCK,
Battelle-Northwest, Richland, Wash.
J. M. Dean.
Biological Effects of Thermal Discharges: Annual Progress Report for 1968, p 41-46, Dec 1969. 2 tab, 3 fig.

Descriptors: *Thermal stress, *Acclimatization, *Fish behavior, *Mortality, Chinook salmon, Salmonids, Water temperature, Thermal pollution, Fishkill, Resistance, Fish physiology.
Identifiers: *Thermal shock, *Thermal tolerance, Coho salmon, Muscle temperature.

Juvenile coho and chinook salmon were acclimated at 10, 15, or 20 deg C and transferred in lots of ten to water temperatures of 25-30 deg C. Temperature acclimation will shift the thermal limits of behavioral and physiological responses. The absolute limits differed for various species of salmonids but the overall response was similar. The author stressed the need for more observations of the reactions of organisms to thermal stress so that adequate thermal criteria can be established. (Sjolseth-Washington)
W70-04163

PERSISTENCE OF CARBARYL IN THE MARINE ESTUARINE ENVIRONMENT. CHEMICAL AND BIOLOGICAL STABILITY IN AQUARIUM SYSTEMS,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife; and Oregon State Univ., Corvallis. Dept. of Agricultural Chemistry.
J. F. Karinen, J. G. Lamberton, N. E. Stewart, and L. C. Terriere.
Journal of Agricultural and Food Chemistry, Vol 15, p 148-156, Jan-Feb 1967. 2 tab, 5 fig, 16 ref. US Public Health Service Research Grant 5 RO1 EF 00628-02.

Descriptors: *Persistence, *Carbamate pesticides, *Estuarine environment, *Degradation, Carbon radio isotopes, Pesticide removal, Hydrolysis, Pest control, Mud flats, Colorimetry, Stability, Absorption.
Identifiers: *Sevin, *1-naphthol, *Carbaryl, Radiometric analyses.

Colorimetric and radiometric analyses were used to study the persistence of carbaryl in estuarine water and mud in laboratory aquaria held at two temperatures. In the absence of mud, the carbaryl concentration decreased approximately 50% in 38 days at 8 deg C. Most of this decrease was accounted for by the production of 1-naphthol. At 20 deg C after 17 days, the carbaryl had almost completely disappeared, with 43% converting to 1-naphthol. When mud was present, both carbaryl and 1-naphthol declined to less than 10% in the sea water in 10 days. Both compounds were adsorbed by the mud, where decomposition continued at a slower rate. Radioactive carbon dioxide was produced in the aquaria containing 14C carbonyl-labeled and 14C ring-labeled carbaryl, indicating decomposition by hydrolysis of the carbamate and oxidation of the naphthyl ring. The total recovery of the 14C activity was only 40%. It is postulated that much of the remainder was evolved as methane. In a preliminary field experiment in which a portion of a mud flat was treated with carbaryl at rates similar to those used in the control of pests of oyster beds, carbaryl could be detected in the mud for 42 days. 1-Naphthol persisted in significant quantities for only one day. (Katz and Sjolseth-Washington)
W70-04164

ACUTE TOXICITY OF THE INSECTICIDE SEVIN AND ITS HYDROLYTIC PRODUCT 1-NAPHTHOL TO SOME MARINE ORGANISMS,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
Nelson E. Stewart, Raymond E. Millemann, and Wilbur P. Breese.
Transactions of the American Fisheries Society, Vol 96, No 1, p 25-30, Jan 1967. 2 tab, 20 ref. US Public Health Service Research Grant 5 RO1 EF 00628-02.

Descriptors: *Pesticide toxicity, *Crustaceans, *Mollusks, *Bioassays, Shrimp, Crabs, Perches, Stickelbacks, Mortality, Resistance, Water temperature, Larvae.
Identifiers: *Sevin, *1-naphthol, *Tolerance, Mytilus edulis, Crassostrea gigas, Clinocardium nuttallii, Parophrys vetulus.

The acute toxicity of Sevin (1-naphthyl N-methylcarbamate) and its hydrolytic product 1-naphthol to 10 species of marine animals was determined. Sevin was more toxic to larval and adult crustaceans (Upogebia pugettensis, Callianassa californiensis, Hamigrapsus oregonensis, Cancer magister) than to larval and adult mollusks. (Mytilus edulis, Crassostrea gigas, Clinocardium nuttallii) and juvenile fishes (Cymatogaster aggregata, Parophrys vetulus, Gasterosteus aculeatus). Sevin was 30 to 300 times more toxic than 1-naphthol to the crustaceans but less toxic than 1-naphthol to the mollusks and fishes. (Katz and Sjolseth-Washington)
W70-04165

REDUCED OXYGEN TOLERANCE AND TOXICITY OF PETROLEUM PRODUCTS TO JUVENILE AMERICAN SHAD,
Bureau of Commercial Fisheries, Beaufort, N.C. Biological Lab.
Marlin E. Tagatz.
Chesapeake Science, Vol 2, No 1-2, p 65-71, Mar-June 1961. 5 tab, 20 ref.

Descriptors: *Bioassay, *Oxygen requirements, *Dissolved oxygen, *Gasoline, Water pollution effects, Oily water, Toxicity, Oxygen demand, Oil, Mortality, Fishkill, Fisheries, Acclimatization.
Identifiers: *Petroleum products, *Alosa sapidissima, *Diesel fuel oil, *Tolerances, Bunker oil, American shad.

Experiments were conducted on juvenile American shad, Alosa sapidissima, to indicate tolerance to reduced oxygen, toxicity of petroleum products, and toxicity of petroleum products with accompanying low dissolved oxygen. All mortalities in reduced oxygen tests occurred at dissolved oxygen values of less than 2 ppm with lethal concentrations varying with the rate of reduction. No mortalities occurred when dissolved oxygen was maintained between 2 and 4 ppm. TL sub m values were determined for gasoline, diesel fuel oil, and bunker oil for 24- and 48-hour periods. Gasoline was the most toxic, fuel oil somewhat less toxic, and bunker oil least toxic. The lethality of petroleum products to shad was found to increase when accompanied by low dissolved oxygen. (Katz and Sjolseth-Washington)
W70-04166

ZOOPLANKTON STANDING CROPS IN A NEW AND AN OLD OZARK RESERVOIR,
Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark.
Richard L. Applegate, and James W. Mullan.
Limnology and Oceanography, Vol 12, No 4, p 593-599, 1967. 4 fig, 5 tab, 18 ref.

Descriptors: *Zooplankton, *Standing crop, *Reservoirs, Seasonal, Density, Rotifers, Hydrography, Physicochemical properties, Biological properties, Sampling, Copepods, Daphnia, Fish, Sunfishes, Bass.
Identifiers: *Ozarks (Ark-Mo), Beaver Reservoir, Bull Shoals Reservoir, Cladoceran communities, Entomostracans, Bosmina longirostris, Ceriodaphnia lacustris, Ceriodaphnia quadrangula, Diaphanosoma leuchtenbergianum, Chaoborus, Cladocera, Leptodora kindtii, Moina affinis, Chydorus sphaericus, Leydigia acanthocercoides, Daphnia species, Leydigia quadrangularis, Pleuroxus denticulatus, Alona, Sida, Camptocercus.

Zooplankton populations (April 1964 through June 1966) of Beaver Reservoir before full impoundment are compared with those of 14-year-old Bull Shoals Reservoir, both on the White River in Arkansas-Missouri Ozarks. Seasonal standing crop estimates show a unimodal curve in the old reservoir and a bimodal curve in the new. Significant seasonal differences between the reservoirs occurred in densities, species composition of cladoceran communities, and horizontal distribution. A decrease in Bosmina longirostris densities in 1966 accounted for differences in magnitude of spring pulses between years in Bull Shoals Reservoir. A spring 1966 increase in the standing crop in Beaver Reservoir was associated with species changes within the genus Daphnia. Mean annual standing crops of entomostracans and rotifers were similar in both impoundments. Comparison of mean annual zooplankton standing crops does not indicate abnormally high production in the new reservoir during its filling stages. The standing crop in both reservoirs is rather low in comparison with other waters. Differences in seasonal zooplankton production may have enhanced fish production in the newer reservoir. (Jones-Wisconsin)
W70-04190

WHAT'S KILLING OUR LAKES,
Minnesota Univ., Minneapolis. Dept. Soil Science.
For primary bibliographic entry see Field 02H.
W70-04193

THE UPTAKE OF ORGANIC SOLUTES IN LAKE WATER,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 02H.
W70-04194

LIBERATION OF ORGANIC ACIDS BY GREEN UNICELLULAR ALGAE,
Moscow State Univ. (USSR). Dept. of Microbiology.
I. V. Maksimova, and M. N. Pimenova.
Translated from Mikrobiologiya, Vol 37, No 1, p 77-86, Jan-Feb 1969. Microbiology, Vol 38, No 1, p 64-70, 1969. 7 fig, 4 tab, 17 ref.

Descriptors: *Algae, *Chlorella, *Organic acids, Biomass, Organic compounds, Carbohydrates.
Identifiers: *Green algae, Chlorella vulgaris, Chlorella pyrenoidosa, Volatile acids, Non-volatile acids, Ketoacids, Tamiya's mineral medium, Glyoxylic acid.

An investigation of the qualitative composition of organic acids liberated to the mineral medium by different strains of Chlorella vulgaris and Chlorella pyrenoidosa. Formic, acetic, lactic, pyruvic, a-ketoglutaric, acetoacetic in some cases comprised 25% of the extracellular compound. The filtrates of the algae always contained glyoxic acid. The total quantity of acids and their representation varied with the phase of growth and size of the biomass. Analysis of cells indicated that the acids were not derived from extracellular compounds. Secretion of nonvolatile acids, gradual accumulation of volatile acids, and the sharp increase in ketoacids at high density of the culture suggested that the processes are controlled by different machanisms. (Wilde-Wisconsin)
W70-04195

SPECIAL ASPECTS OF NITROGEN FIXATION BY BLUE-GREEN ALGAE,
Bristol Univ. (England). Dept. of Botany; and Westfield Coll., London (England). Dept. of Botany.
Rosalie M. Cox, and P. Fay.
Proceedings of the Royal Society (B), Vol 172, No 1029, p 357-366, 1969. 2 fig, 3 tab, 30 ref.

Descriptors: *Nitrogen fixation, *Algae, Light, Carbon dioxide, Inhibition, Nitrogen fixing bacteria, Radioactivity technique, Photosynthesis.
Identifiers: *Anabaena cylindrica, ATP, CMU, Nitrogen-15, Pyruvate, Acetylene reduction, Reductant.

More than 90% inhibition of carbon dioxide fixation by p-chlorophenyl-1, 1-dimethylurea (CMU) failed to influence nitrogen fixation by nitrogen-starved cells of Anabaena cylindrica, but retarded the process about 50% in normal cells of the organism. This suggested that nitrogen-fixation in Anabaena is independent of reducing potential generated by the photo-electron transport, but is stimulated by photosynthetically produced carbon skeletons. Increased light augmented nitrogen-fixation in the presence and in absence of CMU thus indicating the essential part of ATP in the process. The established 3:1 ratio of pyruvate decarboxylation to nitrogen-fixation is in agreement with the hypothesis that pyruvate donates hydrogen for nitrogen reduction, and that in blue-green algae the availability of the reductant is not influenced by photosynthesis. (Wilde-Wisconsin)
W70-04249

BIOLOGICAL AND ECOLOGICAL ASPECTS OF NITROGEN FIXATION BY FREE-LIVING MICRO-ORGANISMS,
Westfield Coll., London (England). Dept. of Botany.
W. D. P. Stewart.
Proceedings Royal Society (B), Vol 172, No 1029, p 367-388, 1969. 5 fig, 1 tab, 109 ref.

Descriptors: *Nitrogen fixation, *Microorganisms, Environmental effects, Ecological distribution, Aquatic habitats, Nitrogen fixing bacteria, Actinomycetes, Yeasts, Fungi, Growth rates.
Identifiers: *Free-living microorganisms, Nitrogen transfer, Growth factors, Acetylene reduction technique.

A summary of the effect of energy sources, oxygen, combined nitrogen, iron, molybdenum, and hydrogen ion concentration on nitrogen fixation by free-living bacteria and blue-green algae. The section on ecological significance of free-living nitrogen-fixing microbes enumerates bacteria and blue-green algae active in frigid regions, other uplands, and aquatic habitats. The effect of these organisms on the growth of higher plants is illustrated by examples from laboratory and field trials. During the last 20 years, many nitrogen-fixing bacteria and blue-green algae were added to the original list including genera Azotobacter, Clostridium, Nostoc, and Anabaena. Nevertheless, the overall importance of nitrogen-fixation by free-living organisms on a world-wide scale cannot be assessed because of insufficiency of reliable data. This includes the often over-rated role of Azotobacter and other heterotrophic bacteria. (Wilde-Wisconsin)
W70-04250

A CRITICAL EVALUATION OF THE TROPHIC LEVEL CONCEPT. I. ECOLOGICAL EFFICIENCIES,
Wisconsin Univ., Madison. Dept. of Zoology.
For primary bibliographic entry see Field 02K.
W70-04251

A STUDY OF THE PROFUNDAL BOTTOM FAUNA OF LAKE WASHINGTON,
Washington Univ., Seattle. Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W70-04253

WATER POLLUTION BY NUTRIENTS-SOURCES, EFFECTS AND CONTROL, PAPERS PRESENTED AT 1966 ANNUAL MEETING OF MINNESOTA CHAPTER SOIL CONSERVATION SOCIETY OF AMERICA.
Minnesota Univ., Minneapolis. Water Resources Research Center.
For primary bibliographic entry see Field 05B.
W70-04266

NUTRIENTS AND OTHER FORMS OF POLLUTION,
Minnesota Dept. of Conservation. Waters Section.
Gene H. Hollenstein.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 4-8, June 1969.

Descriptors: *Eutrophication, *Nutrients, Water pollution, Oligotrophy, Water properties, Water quality, Phosphorus, Farm wastes, Nitrogen.
Identifiers: Minnesota waters, Eutrophication control, Nutrient transport.

A brief summary of eutrophication is given. To reduce confusion between the definition of general pollution and nutrient pollution, eutrophication, the end pollution is defined as: the introduction of energy in any form into a resource which could adversely affect or destroy the resource for a particular use. Conversely eutrophication is a form of pollution defined as 'the process of enrichment of waters of lakes and streams with nutrients.' Eutrophication is a result of both natural changes and man's activities. Activities, such as sewage disposal and urbanization are enumerated and blamed for the present rapid increase in the level of eutrophication. There is no single cause or solution to eutrophication. The methods suggested to evaluate the significance and effects of possible nutrients (phosphorus, nitrogen, carbon, trace metals, potassium, silica, and vitamins) are to obtain surface and groundwater flow patterns and quality analysis, primarily on phosphorus and nitrogen entering, leaving, and retained in water bodies being studied. The major problem of eutrophication is finding methods for controlling the rate and amount of eutrophic activity without halting this process. Possible methods of nutrient control and the values

of water are listed. (See W70-04266). (Bannerman-Wisconsin)
W70-04267

DIAGNOSING POLLUTION IN LAKE MINNETONKA,
Minnesota Univ., Minneapolis. Limnological Research Center.
Robert O. Megard.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 9-14, June 1969. 1 fig, 1 tab, 2 ref.

Descriptors: *Phosphorus, *Nitrogen, *Algae, Sewage plants, Chlorophyll, Photosynthesis, Tributaries, Watershed management, Sediments.
Identifiers: Lake Minnetonka (Minn), Nutrient traps, Nutrient influx, Nutrient sources, Phosphorus budget, Aphanizominon flos aquae.

Increased monetary spending on waste disposal and watershed management is suggested as a recourse to deteriorating quality of lakes. An example, is widening the scope of sewage treatment to include objectives of maintaining recreational and aesthetic values of lakes as well as minimizing health hazards. Measuring abundance and daily growth of algae by chlorophyll analysis and photosynthesis experiments respectively, is a method of comparing lakes and assessing effectiveness of nutrient abatement programs. Data was gathered from Lower Lake of Lake Minnetonka adjacent to Minneapolis, Minnesota, and a direct correlation between phosphorus concentration was discovered during July and August. Each pound of phosphorus was considered responsible for 500 lbs of dry algae during the two months. Data on influx of phosphorus from tributaries and concentration in the lake indicated that sediments were the major nutrition trap. There was doubt whether phosphorus released by sediments between May and August was available to algae. Data indicated that reducing phosphorus influx by one-half would substantially control Lower Lake's eutrophication based on the assumption that a large portion of phosphorus is removed by biogeochemical process. (See W70-04266). (Bannerman-Wisconsin)
W70-04268

EFFECT OF EUTROPHICATION ON FISH AND RELATED ORGANISMS,
Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries and Wildlife.
Lloyd L. Smith.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 15-18, June 1969.

Descriptors: *Eutrophication, *Fish harvest, *Fish, *Fish management, *Fish populations, Detritus, Decomposing organic matter, Water pollution effects, Aquatic bacteria, Oxygen, Lakes, Minnesota.
Identifiers: Desirable fish species, Algal growth, Stream oxygen levels, Oxygen depletion, Paper mill pollutants, Sphaerotilus, Walleye pike eggs.

Eutrophication is considered in the framework of fish management, excluding aesthetic considerations and views only effects on total fish populations. Before adverse levels of eutrophication eliminate certain areas from active fish production, nutrient additions increase fish biomass per acre. Often increased production will be accompanied by adverse aesthetic effects. The principal disadvantage of eutrophication to fish is lowering the oxygen supply to 5 parts per million or lower. Below 5 ppm the harvestable crop is reduced and existence of desirable deep cold water species is threatened with a shift to less desirable warm water species. Increasing amounts of hydrogen sulfide produced by decomposing beds of detritus could be lethal to fish and fish eggs. Eutrophication would increase production, while at the same time accelerate natural mortality and shift in species by high hydrogen sulfide concentrations. Long term effects of eutrophication would be increased protein production because of higher annual production of less desirable warm water fish species. (See W70-04266). (Bannerman-Wisconsin)
W70-04269

ANIMAL WASTE DISPOSAL PROBLEMS AND TRENDS IN MINNESOTA,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
Evan R. Allred.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 22-28, June 1969. 2 fig, 3 tab.

Descriptors: *Livestock, *Wastes, *Farm wastes, Organic wastes, Minnesota, Biochemical oxygen demand, Farms, Pollutants, Water pollution sources, Eutrophication.
Identifiers: *Livestock waste disposal, Broiler farms, Livestock wastes comparison, Feedlots, Manure production, Food production wastes, Projected livestock farms, Wastes management.

The growing problem of animal waste disposal resulting from the trend toward concentration of livestock on fewer farms is discussed. Data compiled in Minnesota indicates large percentage of these farm animals are on feed and in confinement. The problem will accelerate as herds grow larger to meet future population demands. By 1980 there is a projected 10-fold increase in the average hog and feed-cattle herd size in Minnesota. Three reasons given for failure to solve animal waste disposal problems are: (1) reluctance to monetary expenditures on adequate methods, (2) because the problem has been considered unrelated to other parts of society, and (3) approaches have been used that are only applicable to other types of waste. Cost involved and the enormity of the problem are realized when data presented indicate a 250,000 bird poultry enterprise has a biochemical oxygen demand waste equivalent to a city population of 25,000. Eutrophication is increased by spreading manure on frozen ground and the consequent runoff in spring thaw. Since the cost of a treatment plant and storage is prohibitive to individual farmers, it is concluded that no immediate, simple solution is in sight. (See W70-04266). (Bannerman-Wisconsin)
W70-04270

MANAGING LIVESTOCK WASTES TO CONTROL POLLUTION,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
James A. Moore.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 29-34, June 1969. 2 tab.

Descriptors: *Pollution control, *Organic loading, *Cattle, *Hogs, *Sheep, *Farm wastes, Water pollution sources, Water quality, Waste disposal, Minnesota, Nitrogen, Phosphorus, Potassium, Aerobic treatment, Water pollution control.
Identifiers: *Manure processing, *Manure disposal, Livestock industry, Manure storage, Oxidation ditch.

High costs and larger quantities of inert and biologically stable materials prohibit many municipal waste treatment systems being used for animal waste disposal. No system has been designed to remove nitrogen and phosphorus in animal wastes. Four steps in the management of manure are suggested: (1) collection, (2) processing, (3) storage, (4) utilization or disposal. Drying manure simplifies sanitation problems because it is stable, relatively odorless, and breeds few flies. Energy required for drying limits method. Anaerobic lagoons are a popular method for stabilizing organic matter, because disposal problems are mostly eliminated. Animal waste can be treated in aerobic oxidation ponds with oxygen supplied by algae and natural reaeration supplemented by mechanical aeration. Impervious-bottom tanks and storage areas should be considered to prevent nutrient leaching during extended holding periods. Although economically non-competitive, more effort to dispose animal waste as fertilizer would alleviate the problem and prove beneficial to soils. (See W70-04266). (Bannerman-Wisconsin)
W70-04271

RUNOFF AND SEDIMENT AS NUTRIENT SOURCES,
Agricultural Research Service, Morris, Minn. North Central Soil Conservation Research Center.
Robert F. Holt.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 35-38, June 1969. 3 tab, 3 ref.

Descriptors: *Surface runoff, *Sediments, *Nutrient sources, Phosphorus, Nitrogen, Minnesota, Lakes, Nutrients, Snowmelt, Sediment load, Agronomic crops, Forages.
Identifiers: Barnes soil, Corn crops, Oats crops, Hay crops, Fallow land, Cropping treatments, Alfalfa plants.

Amounts of nitrogen and phosphorus added to surface waters by runoff depend upon soil texture, vegetation, organic residue, and management practices. Runoff contribution to sediment fertility is based on soil, topography, and vegetation. Data provided indicate large quantities of phosphorus are removed from surface water by sediments. Although sediment contribution to soluble nutrient leach is not known, sediments are not believed to release significant amounts of soluble phosphorus. Data supplied qualifies agricultural runoff as a major contributor of nutrients to surface waters. Crop type and farming techniques influence quantities of phosphorus and nitrogen contributed by runoff. Alfalfa plots contribute the greatest quantities of soluble phosphorus during snowmelt runoff. In most cases eutrophication is regarded as an irreversable process because it is a natural phenomena. (See W70-04266). (Bannerman-Wisconsin)
W70-04272

CONTROLLING NUTRIENTS AND ORGANIC TOXICANTS IN RUNOFF,
Minnesota Univ., Minneapolis. Dept. of Soil Science.
William P. Martin.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 39-47, June 1969. 15 ref.

Descriptors: *Waste water disposal, *Sediments, *Nutrients, *Surface runoff, Groundwater, Erosion, Agricultural watersheds, Minnesota, Lagoons, Waste dilution, Waste disposal, Waste water disposal, Soil properties, Nitrogen, Phosphorus.
Identifiers: Recharge basins, Organic toxicants, Agricultural pollution, Minnesota Soil Survey, Waste spray irrigation, Land waste disposal, Agricultural wastes pollutants, Waste disposal systems.

Increased numbers of soil surveys are essential to each land use decision, specifically in land waste disposal. Leaching, erosion, and groundwater contamination are minimized when suitable soils are chosen for specific uses, such as feedlots. Waste disposal has been practiced without regard for location, which can result in severe contamination in sandy soils that safely accommodate only 100 lbs of nitrogen/acre per growing season. When organic food sources are available, the microbial population of soil is able to decompose almost any amount of organic material introduced. Large quantities of organic materials could be disposed without harming the environment. Nitrate contamination in aerated soils is a serious problem and results from nitrifying bacteria oxidizing ammonia released

from ammonification. Denitrifying bacterial will reduce nitrate concentration under anaerobic conditions. Growing plants will also reduce nitrate concentration. Nitrogen influx into groundwater is reduced by holding lagoons or rotation spreading. Phosphorus is easily fixed in the soil and is not considered a problem. Several successful land waste disposal systems, such as using recharge basins, are discussed. (See W70-04266). (Bannerman-Wisconsin)
W70-04273

TREATMENT OF MUNICIPAL WASTES,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
Walter K. Johnson.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 48-52, June 1969. 2 fig, 1 tab.

Descriptors: *Waste treatment, *Domestic wastes, *Municipal wastes, Wastes, Phosphorus, Nitrogen, Industrial wastes, Infiltration, Denitrification, Chemical precipitation, Biological treatment, Ion exchange, Filtration, Adsorption, Reverse osmosis.
Identifiers: Diurnal concentrations, Commercial wastes, Ammonia stripping.

Limited assimilative capacity of receiving waters restricts the municipal effluent flow allowable before pollution becomes a problem. With increasing population, larger volumes of flow are inevitable, demanding upgrading of wastewater treatment as a pollution preventative. Technology to improve treatment is emphasized as being available, but what is needed now are human and financial resources. Four sources of municipal wastes are discussed: domestic, commercial, industrial, and infiltration. Removing solids from dilute waste water is a major processing problem. Average flow is 120 gallons per day per person. After primary and secondary treatment, which are physical and biological process respectively, comes the removal of nutrients by tertiary treatment. With technology available for all three treatments, municipalities could have a closed water system. For general removal of solids in tertiary treatment the processes of filtration, adsorption, and reverse osmosis are suggested. (See W70-04266). (Bannerman-Wisconsin)
W70-04274

SEPTIC TANK EFFLUENTS,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
Robert C. Polta.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 53-57, June 1969. 1 fig.

Descriptors: *Septic tanks, *Effluents, Groundwater, Nitrification, Nitrogen, Phosphorus, Absorption, Soil types, Ammonia, Wells, Water pollution sources.
Identifiers: Groundwater contaminants, Phosphorus fixation.

Septic tanks are a potential source of nitrogen and phosphorus contamination due to effluent discharge by means of tile fields and seepage pits. Groundwater can then pollute surface water by direct flow or indirectly, by pumping and subsequent surface discharge. Many soils reduce possible phosphorus contamination by their tremendous phosphorus fixing ability. Fixation processes include adsorption, mineral crystal structure may be changed by replacement reaction, and formation of insoluble phosphorus compounds and subsequent precipitation. Fixation can remove as much as 8000 lbs phosphorus/acre to a depth of 6 inches. Extent of nitrogen flow in groundwater is affected by adsorption-ion exchange phenomena exhibited by soils, and action of nitrifying and denitrifying bacteria. Since most nitrogen is ammonia, as much as 10 milligrams nitrogen/100 grams can be adsorbed by basic, negatively charged soils. Nitrogen mobility is increased by nitrifying bacteria converting nitrogen compounds to nitrates, which is not adsorbed. At the present there is no practicable method to limit nitrification. Although phosphorus is not a serious threat, nitrogen groundwater contamination has been found considerable distances from the source. Eutrophication and methemoglobinemia could result from groundwater nitrogen. (See W70-04266) (Bannerman-Wisconsin)
W70-04275

WATER POLLUTION IN RECREATIONAL AREAS--SOURCES AND CONTROL,
Forest Service (USDA), Ely, Minn. Superior National Forest.
Michael A. Barton.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 58-63, June 1969. 1 tab, 7 ref.

Descriptors: *Water pollution sources, *Water pollution control, *Waste disposal, Minnesota, Clearcutting, Recreation wastes.
Identifiers: Silvicultural practices, Herbiciding, Honeywagons.

Although water pollution is not severe in recreational areas, demand for high water quality necessitates pollution control. Prevention programs are emphasized as more promising and less costly than correction programs. Primary water pollution problem in recreational areas is nutrient enrichment, which is surprisingly high, because visitors concentrate in small areas compared to total park area. Another significant nutrient source is water inflow from municipalities. Disposal is a special problem in wilderness areas. Nutrient export by airplane and helicopter 'honeywagons', or combustion toilets have been suggested. Oil from outboard motors exerts an oxygen demand. Silviculture practices of clearcutting and herbiciding can increase stream nitrogen concentration 20 times. Natural input of nutrient from soils and vegetation in the watershed are verified as significant sources by given data. Establishing monitoring system of physical, chemical, and biological parameters is suggested to measure effectiveness of control measures. (See W70-04266). (Bannerman-Wisconsin)
W70-04276

THE USE OF A DEEP TANK IN PLANKTON ECOLOGY. I. STUDIES OF THE GROWTH AND COMPOSITION OF PHYTOPLANKTON CROPS AT LOW NUTRIENT LEVELS,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
J. D. H. Strickland, O. Holm-Hansen, R. W. Eppley, and R. J. Linn.
Limnology and Oceanography, Vol 14, No 1, p 23-34, 1969. 9 fig, 4 tab, 17 ref.

Descriptors: *Plankton, *Laboratory tests, *Ammonia, *Nitrate, Silica, Proteins, Carbohydrates, Phosphorus, Lipids, Chlorophyll, Phytoplankton, Nutrient requirements.
Identifiers: Phytoplankton growth, Phytoplankton composition, Nutrient levels, Ditylum brightwellii, Cachonina nici, Gonyaulax polyedra, Phaeocystis, DNA, ATP, Chlorophyll a, Chlorophyll c.

A cylindrical tank, 3 meters in diameter and 10 meters tall, was used to grow phytoplankton crops under simulated natural conditions of nutrient concentration and cell density. Construction and operation of the tank are described. Three, two-week, growth experiments were performed using Ditylum brightwellii (a centric diatom), Cachonina nici (an armored dinoflagellate), with a mixed crop of the dinoflagellate Gonyaulax polyedra and Phaeocystis (a colonial member of Haptophyceae). In each experiment the chemical composition of the tank-grown cultures were analysed for cell carbon, nitrogen, phosphorus, lipid, carbohydrate, DNA, ATP, chlorophyll a, and carotenoids. Successful nitrogen budgets were achieved with D brightwellii and C nici. Nearly all the ammonia was used before any nitrate was assimilated. With D brightwellii, there was a marked increase in chlorophyll, phosphorus, and ATP contents when the cells switched from ammonia to nitrate. Lipid content increased nearly twofold in nitrate-grown cells. Unlike the behavior found with D brightwellii, the cells of C nici grown on nitrate had approximately equal values of lipid, chlorophyll, phosphorus, and ATP as cells grown on ammonia. Carbohydrate contents, however, increased sixfold in nitrogen-starved cells. Upon addition of nitrate the concentration of carbohydrates decreased appreciably. (Haskins-Wisconsin)
W70-04278

THE KINETICS OF NITRATE AND AMMONIA UPTAKE BY NATURAL POPULATIONS OF MARINE PHYTOPLANKTON,
Washington Univ., Seattle. Dept. of Oceanography.
J. J. MacIsaac, and R. C. Dugdale.
Deep-Sea Research, Vol 16, p 45-57, 1969. 8 fig, 3 tab, 17 ref.

Descriptors: *Kinetics, *Nitrates, *Ammonia, *Population, *Marine plants, *Phytoplankton, Tracers, Alaska, Pacific Ocean, Enzymes, Nutrients, Productivity, Oligotrophy, Eutrophication, California, Gulfs, Spectrometers, Sampling, Nitrites, Radioisotopes, Detritus, Light intensity, Depth, Mexico, Velocity, Incubation, Silicates, Phosphates, Vitamin B, Trace elements, Iron, Growth rates, Tropical regions.
Identifiers: *Uptake, Nitrogen-15, Bering Sea (Alaska), Michaelis-Menten equation, Stephen's Passage (Alaska), Particulate, Costa Rica, Nutrient concentration, Cyclotella nana, Phaedactylum tricornutum, Euphotic zone.

Natural marine phytoplankton populations response to nitrate and ammonia concentrations has been investigated using nitrogen-15 tracer techniques. Bering Sea, waters off southeastern Alaska, and northeastern tropical Pacific experiments suggest that uptake of both compounds follows the Michaelis-Menten expression for enzyme kinetics. A hyperbola describes the relationship between the concentration of nitrate or ammonia and uptake of that nutrient. Such a hyperbola can be obtained in experiments with ammonia and, under suitable conditions, with nitrate. The value of K-sub-t, nutrient concentration at which the maximum uptake rate is reduced by 1/2, is related to the nutrient and productivity regime of the region inhabited by the population. In the tropical oligotrophic area investigated, K-sub-t nitrate is less than 0.2 micrograms atoms/liter, while in corresponding eutrophic regions, K-sub-t nitrate exceeds 1.0 micrograms atoms/liter. These values suggest that phytoplankton populations of oligotrophic regions are adapted to low ambient nutrient concentrations and are able to take up nutrients at a higher rate under these conditions than would phytoplankton species characteristic of eutrophic conditions and showing a higher K-sub-t value. (Jones-Wisconsin)
W70-04279

STUDY OF BACTERIA ASSOCIATED WITH MARINE ALGAE IN CULTURE. I. PRELIMINARY DETERMINATION OF SPECIES (FRENCH),
Station Marine d'Endoume, Marseille (France).
For primary bibliographic entry see Field 02H.
W70-04280

TOXICITY AND ENVIRONMENTAL REQUIREMENTS OF A STRAIN OF APHANIZOMENON FLOS-AQUAE (L) RALFS,
National Marine Water Quality Lab., West Kingston, R.I.
John H. Gentile, and Thomas E. Maloney.
Canadian Journal of Microbiology, Vol 15, No 2, p 165-173, 1969. 7 fig, 2 tab, 25 ref.

Descriptors: *Toxicity, *Nutrient requirements, *Cyanophyta, *Environment, Nitrogen fixation, Hydrogen ion concentration, Growth rates, Temperature, Phosphorus, Age, Light intensity, Assay, Fish, Crustaceans, Daphnia, Copepods, Killifishes, Dissolved oxygen, Bacteria, Cytological studies, Biochemistry, Spores, Carbon radioisotopes, Bicarbonates, Incubation, Shiners, Copper sulfate.
Identifiers: *Aphanizomenon flos-aquae (L) Ralfs, Tris, Fundulus heteroclitus, Cyprinodon variegatus, White mice, Notemigonus crysoleucas, Bosmina longirostris, Daphnia catawba, Ostracods, Chydorid cladocerans, Microcrustaceans, Microcystis aeruginosa, Anabaena flos-aquae, Gloeotrichia ecinulata, Nitzschia, Endotoxin, Contaminants, Algal bloom.

A toxic strain of Aphanizomenon flos-aquae was isolated and cultured in a defined medium (ASM-1). This strain fixes nitrogen, has pH optimum of 7.5 and maximum growth rates at 5000 lux and 26C. Phosphorus levels of 1.0 micromoles readily supported populations of 100,000 cells/milliliter with growth stimulation evident at concentration of 0.1 micromoles phosphorus. Tris is inhibitory to growth at concentrations above 2.5 micromoles. Toxin production is related to culture age, temperature, and light intensity but not nitrogen source. Intraperitoneal injection of toxic extracts into Fundulus heteroclitus, Cyprinodon variegatus, and white mice gave a LD (100%) of 0.5 milligrams/kilogram, 0.5 milligrams/kilogram, and 8 milligrams/kilogram, respectively. Assays with Notemigonus crysoleucas and Bosmina longirostris indicate that toxin from naturally occurring bloom populations (1,000,000 cells/milliliter) if total released simultaneously, could kill certain fish species and microcrustaceans. Daphnia catawba was more toxin resistant (LD (100%) equals 1.0 milligrams/milliliter) while cyclopod copepods, ostracods, and chydorid cladocerans were unaffected by toxin concentrations of 2.0 milligrams/milliliter. Ecological significance of this toxic alga in relation to fish kills is discussed. (Jones-Wisconsin)
W70-04282

PHYTOPLANKTON AND RELATED WATER-QUALITY CONDITIONS IN AN ENRICHED ESTUARY,
Geological Survey, Tacoma, Wash.
For primary bibliographic entry see Field 02L.
W70-04283

COMPETITION BETWEEN PLANKTONIC BACTERIA AND ALGAE FOR ORGANIC SOLUTES,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 02H.
W70-04284

A NEW METHOD FOR THE STUDY OF BACTERIA IN LAKES: DESCRIPTION AND RESULTS,
North Carolina State Univ., Raleigh. Dept. of Zoology; and Gordon Coll., Wenham, Mass.
For primary bibliographic entry see Field 02H.
W70-04287

ANNUAL AUTOTROPHIC PRODUCTION OF PHYTOPLANKTON IN LAKE BAIKAL,
For primary bibliographic entry see Field 02H.
W70-04290

STUDIES OF A SIMPLE LABORATORY MICROECOSYSTEM: BACTERIAL ACTIVITIES IN A HETEROTROPHIC SUCCESSION,
Georgia Univ., Athens, Dept. of Microbiology; and Georgia Univ., Athens. Dept. of Zoology.
Robert W. Gordon, R. J. Beyers, E. P. Odum, and R. G. Eagon.
Ecology, Vol 50, No 1, p 86-100, 1969. 8 fig, 12 tab, 54 ref.

Descriptors: *Laboratories, *Ecosystems, *Bacteria, Aquatic microorganisms, Chlorella, Vitamin B, Carbon dioxide, Nitrogen, Primary productivity, Decomposing organic matter, Photosynthesis, Respiration, Biomass, Biological communities, Metabolism, Carbon radioisotopes, Sewage, Texas, Biochemistry, Electron microscopy, Pseudomonas, Enzymes, Fungi, Organic matter, Lactobacillus, Spectrophotometry, Chromatography, Scenedesmus, Depth, Stratification.
Identifiers: *Heterotrophic succession, Excretions, Dissolved carbon, Particulate, Microcosm, Austin (Tex), Flagellates, Heterotrophic, Ostracods, Xanthomonas, Bacillus, Chromogenic characteristics, Species diversity, Glyoxylate, Radioautography, Optical density, Growth factors, Schizothrix calciocola, Paramecium bursaria, Lepadella.

Eleven species or functional types of heterotrophic bacteria were isolated during study of heterotrophic succession in an aquatic microcosm. Bacterial population numbers and dominant types changed rapidly. Dominant primary producer, Chlorella, depended upon thiamin supplied by five bacterial isolates. Bacteria were functional contributors of thiamin, carbon dioxide, and possibly nitrogen sources to primary producers; as primary consumers of algal excretions; as secondary consumers of bacterial excretions; as decomposers. During succession net photosynthesis surpassed night respiration from day 5 through 45; as maturity approached the photosynthesis respiration ratio fluctuated around 1. Dissolved carbon was present at 240 milligrams/liter at zero time and decreased owing to heterotrophic activity of 0.0000000015 bacterial cells/milliliter by day 8 and maintained at approximately 20.7 milligrams carbon/liter from day 8 through maturity. Particulate biomass increased steadily until day 50; no further increase followed. Bimodal pattern showed in bacterial numbers, Chlorella numbers, community metabolism, carbon-14-U glyoxylate uptake and bacterial species diversity. Peaks appeared early and late in succession with mid-succession decrease in activity. The microcosm exhibited trends expected of larger, more open, developing ecosystems. Methods are useful tools for examining ecological principles. (Jones-Wisconsin)
W70-04291

THE RIGHT TO A CLEAN ENVIRONMENT,
Mount Sinai School of Medicine, New York. Dept. of Community Medicine.
Eric J. Cassell.
Archives of Environmental Health, Vol 18, p 839-843, 1969.

Descriptors: *Air pollution, *Air pollution effects, *Mortality, Population, Public health, Sulfides, Environmental effects.
Identifiers: *Sulfur dioxide, Catalytic metals, Donora (Pa), London, Synergism, New Florence (Pa), Seward (Pa).

Research in air pollution was stimulated by the death of 22 persons in Donora, a Pennsylvania town of 14,000, and the illness of about half that population. The toxic substances, ranging from sulfur dioxide to hydrocarbons, caused eye irritation, chronic bronchitis, and increased mortality. The 1952 London air pollution episode produced some 4,000 deaths above normal in two weeks. The ill effects of sulfur dioxide appear to materialize only when air contains some particulate matter or catalyzing particles that convert sulfur dioxide to sulfuric acid. Gasoline, plastic bags, transistors, food packaging, building materials, drugs, and endless other substances carry copper, nickel, vanadium, titanium, boron, barium, and numerous other catalytic metals which end their life in the air via incinerators. (Wilde-Wisconsin)
W70-04292

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME I.
Federal Water Pollution Control Administration, Washington, D.C.
Federal Water Pollution Control Administration Report to Congress, Nov 3, 1969. 130 p, 3 fig.

Descriptors: *Estuaries, *Water resources development, *Water management (Applied), *Environmental effects, *Water pollution control, Surveys, Environmental sanitation, Water pollution effects, Regulation, Waste disposal, Sewage treatment, Water pollution sources, Recreation, Fishing, Transportation, Economics, Social aspects.
Identifiers: Estuarine resources management.

Existing pertinent information on estuarine environments is assembled, coordinated, and organized, and additional investiations and surveys were carried out to supplement existing information. Not only are recommendations made for a national program, but also an analysis of the importance of estuaries in the economic and social environment and the effects of pollution on the natural ecosystem is given. Major economic, social, and ecological trends were examined to show what the future might hold; and recommendations are made for research and study to acquire basic knowledge needed to manage future trends. The recommended national program is based on institutional management with multiple long-term use as a common denominator. Formation of the organizations to accomplish this and the active implementation of these recommendations will permit maximum use of the entire estuarine zone while preserving it for the benefit of future generations. (Knapp-USGS)
W70-04299

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME II.
Federal Water Pollution Control Administration, Washington, D.C.
Federal Water Pollution Control Administration Report to the Congress, Nov 3, 1969. 575 p, 38 ref.

Descriptors: *Estuaries, *Water resources development, *Water management (Applied), *Environmental effects, *Water pollution control, Surveys, Environmental sanitation, Water pollution effects, Regulation, Waste disposal, Sewage treatment, Water pollution sources, Recreation, Fishing, Transportation, Economics, Social aspects.
Identifiers: Estuarine pollution.

The existing relationship between the biophysical environment and the socioeconomic environment in the estuarine zone of the U.S. is described. The estuarine zones before man's use as well as the uses of the estuarine zone and their effects on the land, the water, and the life are discussed. What will happen to the estuarine zone unless man controls his impact on this part of his environment is shown. The biophysical environment divides naturally into ten geographical regions, each dominated by a different combination of environmental conditions. The discussion revolves about these biophysical regions as the primary subdivisions of the natural environment of the estuarine zone. Because of the similarity of environmental conditions within it, each region has estuarine systems, uses, and problems which are typical of the region, if not unique to it. The essential unity of the estuarine zone as a unique resource is emphasized because an effective national management program needs to use knowledge gained in one region to solve problems in the others. (Knapp-USGS)
W70-04300

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME III.
Federal Water Pollution Control Administration, Washington, D.C.
Federal Water Pollution Control Administration Report to the Congress, Nov 3, 1969. 640 p, 8 fig, 33 tab, 31 ref.

Descriptors: *Estuaries, *Water resources development, *Water management (Applied), *Environmental effects, *Water pollution control, Surveys,

Environmental sanitation, Water pollution effects, Regulation, Waste disposal, Sewage treatment, Water pollution sources, Recreation, Fishing, Transportation, Economics, Social aspects.
Identifiers: Estuarine resources management.

Background material is compiled for the National Estuarine Pollution Study. To provide a basis for developing recommendations and defining responsibilities, a volume of material was amassed on the views, suggestions, programs, and legislative authorities of all sectors of the National community -- Federal, State, and local governments, and public and private interests. The resulting material consists of reports, correspondence, and personal communications which were analyzed and summarized to produce relatively brief overviews. The organizations include Federal agencies, State agencies, local governments, compact (or interstate) agencies, and public and private interests. These overviews were related to those of other marine resource studies and then related to specific geographic areas to present a concrete overall view, and finally summarized in the form of Conclusions. A skeletal outline is provided for the development of recommendations. Guidelines are suggested for a management statute. (Knapp-USGS)
W70-04301

THE IMPACT OF MINE DRAINAGE POLLUTION ON INDUSTRIAL WATER USERS IN APPALACHIA,
Battelle Memorial Inst., Columbus, Ohio.
For primary bibliographic entry see Field 05G.
W70-04329

THE IMPACTS OF MINE DRAINAGE POLLUTION ON LOCATION DECISIONS OF MANUFACTURING INDUSTRY IN APPALACHIA.
Fanus Co., Inc., New York.
For primary bibliographic entry see Field 05G.
W70-04332

IMPACT OF MINE DRAINAGE ON RECREATION AND STREAM ECOLOGY: APPENDIX E. MINE DRAINAGE POLLUTION AND RECREATION IN APPALACHIA.
Nathan (Robert R.) Associates, Inc., Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-04333

EFFECT OF INDUSTRIAL EFFLUENT ON WATER QUALITY OF LITTLE SIX MILE CREEK NEAR JACKSONVILLE, FLORIDA,
Geological Survey, Ocala, Fla.
Donald A. Goolsby.
Available from Superintendent of Documents, U S Government Printing Office, Washington, D C 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D240-D243, 1969. 4 p, 4 fig, 1 tab, 1 ref.

Descriptors: *Water pollution effects, *Acidic water, *industrial wastes, *Florida, Water quality, Data collections, Sampling, Monitoring, Acidity, Dissolved oxygen, Solutes.
Identifiers: Jacksonville (Fla).

A reconnaissance of Little Six Mile Creek near Jacksonville, Fla., made August 24-26, 1965, showed that acid industrial effluent has severely affected the entire stream, and during low flow, the upper Ribault River. The total acid load of the effluent during this reconnaissance was equivalent to 1.7 tons per day as sulfuric acid and the dissolved-iron load was equivalent to 0.4 ton per day. At times the acid effluent is neutralized by alkaline effluent from a tributary stream. (Knapp-USGS)
W70-04344

THE RATE OF LIBERATION OF PHOSPHATE IN SEA WATER BY THE BREAKDOWN OF PLANKTON ORGANISMS,
Marine Biological Association of the United Kingdom, Plymouth (England). Lab.
L. H. N. Cooper.
Journal of the Marine Biological Association of the United Kingdom, Vol 20, p 197-200, 1941. 1 fig, 1 tab, 6 ref.

Descriptors: *Phosphates, *Sea water, *Plankton, Zooplankton, Phytoplankton, Time, Diatoms, Sampling.
Identifiers: *Phosphate liberation, *Inorganic phosphate, Phosphate-phosphorus breakdown, Calanus, Acartia, Temora, Ctenophores, Rhizosolenia, Skeletonema costatum, Guinardia flaccida.

Four experiments were made to determine the rate inorganic phosphate is set free from plankton. Samples of animal and plant plankton caught in fine and very fine silk tow-nets were analyzed for phosphorus, and aliquot parts filtered on a silk disc. They were added to sea water in glass vessels and subsequent changes in the phosphate content of water followed. Breakdown of zooplankton was very rapid and more phosphate was released than the original addition as plankton. The balance was produced from dissolved organic phosphorus compounds in the water. Breakdown of phytoplankton showed a short time lag and only a portion of phosphorus added was freed as phosphate. An inflection in the curves was noted after 15-20 days' storage. Rate of liberation slowed and accelerated again before reaching the maximum. A slow fall in phosphate occurred during the four months after the maximum had been reached; no explanation is apparent for this, although molds may be involved. Experimental waters were much richer in plankton than sea water ever is, thus presumably, all processes of decay were greatly accelerated, compared with natural conditions. (Jones-Wisconsin)
W70-04366

ECOLOGY AND CHARACTERIZATION OF YEASTS FROM AQUATIC REGIONS OF SOUTH FLORIDA,
Miami Univ., Fla. Dept. of Microbiology; and Miami Univ., Fla. Inst. of Marine Sciences.
D. G. Ahearn, F. J. Roth, Jr., and S. P. Meyers.
Marine Biology, Vol 1, No 4, p 291-308, June 1968. 9 fig, 7 tab, 36 ref.

Descriptors: *Ecology, *Yeasts, *Florida, *Aquatic environments, Fresh water, Salinity, Bioindicators, Fungi, Habitats, Sampling, Estuaries, Systematics, Sea water, Hydrogen ion concentration, Molds.
Identifiers: *South Florida waters, Miami (Fla), Everglades (Fla), Lake Okeechobee (Fla), Candida, Physiological charactertistics, Saccharomyces fructuum, Debaryomyces hansenii, Cryptococcus laurentii, Cryptococcus albidus, Rhodotorula, Torulopsis glabrata, Torulopsis ernobii, Hansenula anomala, Pichia, Trichosporon cutaneum, Kluyveromyces aestuarii, Sporobolomyces, Spirodela, Ascosporogenous, Asporogenous, Morphological.

The composite aquatic regions of southern Florida and adjacent areas were the site of mycological investigations based on more than 1000 yeasts collected and exceeding 50 representative taxa. Highest yeast densities were found in fresh waters with the recovery of yeasts per sample decreasing from 100% to approximately 70% with lowered organic content, increasing salinity and remoteness from land. Average cell population densities, species, variety, and particularly the number of sexual yeasts, decreased in saline samples. The isolation media used were evaluated and discussed in terms of yeast densities obtained. Strictly oxidative species of Candida, Cryptococcus, and Rhodotorula and the sexual yeast, Debaryomyces hansenii, were widespread in all the habitats studied and predominated in water of relatively low organic content. Selective survival of certain yeasts in various aquatic environments is suggested. Definite distributional patterns were exhibited by various taxa and the possible existence of 'indicator' species is indicated. Systematics of fungi are reviewed at length and the significance of strain differences considered and discussed, as related to the unique characteristics of the various ecological habitats. (Jones-Wisconsin)
W70-04367

YEASTS FROM THE NORTH SEA,
Miami Univ., Fla. Inst. of Marine Sciences; Miami Univ., Fla. Dept. of Microbiology; and Biologische Anstalt Helgoland (West Germany).
S. P. Meyers, D. G. Ahearn, W. Gunkel, and F. J. Roth, Jr.
Marine Biology, Vol 1, No 2, p 118-123, 1967. 6 fig, 1 tab, 19 ref.

Descriptors: *Yeasts, Population, Marine plants, Dinoflagellates, Oceans, Bioindicators, Fungi, Estuaries, Bacteria, Sampling, Seasonal, Hydrography, Florida, Thermocline, Currents (Water), Phytoplankton, Zooplankton, Hydrogen ion concentration, Algae.
Identifiers: *North Sea, Mycota, Debaryomyces hansenii, Rhodotorula rubra, Candida diddensii, Candida zeylanoides, Candida krusei, Candida obtusa, Candida tropicalis, Noctiluca miliaris, Helgoland (Germany), Aureobasidium pullulans, Hanseniaspora uvarum, Radulespores, Zymological, Elbe (Germany), Sporobolomyces roseus, Autolysis, Ascosporogenous.

Mycological examination of estuarine and open ocean environments have revealed diverse populations of yeast of various taxa and physiological groups. Evidence indicates that these microorganisms are normal components of ocean biota, and that certain species may serve as bio-indicators for specific water masses and conditions. Data are needed on the mycota associated with algal 'blooms' and their effect on growth stimulation and reproduction of fungi. Yeasts were isolated from twelve established sites in the North Sea from 1964 to 1966. A percentage frequency of 99% with populations varying from less than 10 to more than 3000 viable cells/liter was observed. This mycota was characterized by considerable spatial and temporal fluctuations, with the dominant yeast present the ascosporogenous species, Debaryomyces hansenii. This taxon, as well as other common North Sea yeasts, Rhodotorula rubra and Candida diddensii, have been reported frequently from other marine locales. Noteworthy concentrations of yeasts, especially D hansenii, were observed during summer, often in association with various stages of development of the dinoflagellate, Noctiluca miliaris. Population dynamics of the North Sea yeasts are discussed in relation to similar studies of other marine environments. (Jones-Wisconsin)
W70-04368

THE PHYSIOLOGY OF AN ALGAL NUISANCE,
Westfield Coll., London (England). Dept. of Botany.
G. E. Fogg.
Proceedings Royal Society B, Vol 173, p 175-189, 1969. 4 fig, 84 ref.

Descriptors: *Nuisance algae, Cyanophyta, Vitamins, Peptides, Organic matter, Trace elements, Light intensity, Chlamydomonas, Chlorella, Enzymes, Carbon dioxide, Growth rates, Plankton, Oxygen, Nitrogen fixation, Nitrates, Electron microscopy, Ammonia, Spectrometers, Diffusion, Turbulence, Toxins, Bacteria, Copper sulfate, Circulation.
Identifiers: *Physiology, Spirogyra, Myxophyceae, Microcystis, Coelosphaerium, Oscillatoria, Anabaena, Aphanizomenon, Gloeotrichia, Polypeptides, Photoassimilation, Berkelse Lake (Netherlands), Heterocysts, Gas-vacuoles, Llangors Lake (Wales), Halobacterium, Respirometer, Protoplasm, Water-blooms, Lake George (Uganda), Rhine-Meeuse delta (Netherlands), Hohlspindeln, Myxophycean blooms.

Physiology of Microcystis, Coelosphaerium, Oscillatoria, Anabaena, Aphanizomenon, and Gloeotrichia are discussed relative to development of blooms. Since the algae form gelatinous masses, local exhaustion of ammonia may force cells to utilize the nitrogen molecule, aggravating eutrophication. Remarkable features of the planktonic blue-green algae are cells containing gas-vacuoles. These gas-filled cavities in protoplasm appear as indefinite, irregular, refractive bodies. The relatively high buoyant density of their membranes shows them as probably at variance to other cellular membranes. They are specific structures with definite selective value. Perhaps gas-vacuole formation in dim light causes a cell or colony to rise; inhibition of gas-vacuole formation, and continued growth and cell division nearer the surface subsequently causing it to become heavier and sinking. This up and down movement would contribute to maximum absorption of mineral nutrients. Near the surface light inhibition of photosynthesis may result in inability to 'dilute out' the gas-vacuoles by growth, thus the alga remains floating and becomes moribund. Copper sulphate usage for control of myxophycean water-blooms is questionable. Inhibiting formation of these gas-vacuoles or their destruction by ultrasonic radiation, or other means, might effectively control the nuisance. Artificial circulation may break down chemical stratification in the water. (Jones-Wisconsin)
W70-04369

PERIPHYTON GROWTH ON ARTIFICIAL SUBSTRATES IN A RADIOACTIVELY CONTAMINATED LAKE,
Oak Ridge National Lab., Tenn. Radiation Ecology Section.
Ernest C. Neal, Bernard C. Patten, and Charles E. DePoe.
Ecology, Vol 48, No 6, p 918-924, 1967. 1 fig, 1 tab, 17 ref.

Descriptors: *Periphyton, *Radioactivity, *Lakes, Productivity, Radioisotopes, Temperature, Depth, Bacteria, Slime, Algae, Cyanophyta, Diatoms, Chlorophyta, Light intensity, Succession, Zinc radioisotopes, Cesium, Cobalt radioisotopes, Seasonal, Radiochemical analysis, Monitoring, Pigments, Phytoplankton, Waste water (Pollution), Photosynthesis, Chlamydomonas, Chlorella, Euglena, Scenedesmus, Protozoa, Nematodes, Surfaces.
Identifiers: *Growth dynamics, *Bacterial colonization, *Artificial substrates, *Radionuclide accumulation, Ruthenium-106, White Oak Lake (Tenn), Activity-density, Vertical, Microcystis, Oscillatoria, Navicula, Cymbella, Lyngbya, Fragilaria, Oedogonium, Spirogyra, Chaetophora, Stigeoclonium, Ankistrodesmus, Aphanocapsa, Chroococcus, Closterium, Gleocapsa, Spirulina, Ulothrix, Chironomids, Melton Hill Dam (Tenn), Cobalamin.

Periphyton colonization, biomass development and radionuclide accumulation were studied by suspending polyethylene tape vertically for periods to 9 weeks in a radioactively contaminated lake. Biomass growth was nearly complete on upper tape sections after 2 weeks, but full development on lower sections took longer; maximum biomass occurred at 25.4 to 50.8 centimeters depth. Blue-greens were initial algal dominants, succeeded by diatoms and filamentous greens. Species succession continued beyond biomass equilibrium, with blue-greens important in deeper zones and greens developing best in upper, lighted regions. Radioisotope concentrations equilibrated rapidly in both artificial substrates and periphyton biomass. Zinc-65 was concentrated highly by the polyethylene tape, Cesium-137 moderately, and Cobalt-60 and Ruthenium-106 negligibly, if at all. Ambient concentrations of zinc-65 in water and periphyton were below detection. The other isotopes contributed about equally to biomass radioactivity. Biomass activity-densities of Ruthenium-106 and Cesium-137 increased slightly with depth; this pattern was pronounced for Cobalt-60. Factors considered to account for observed vertical distributions include: different radioisotope concentrations in surface and deep water; a hyperbolic rather than linear relationship between activity-density and biomass; and concentration of Cobalt-60 by blue-green algae as an essential element, or by microbiota for use in cobalamin synthesis. (Jones-Wisconsin)
W70-04371

PRIMARY PRODUCTIVITY IN THE GULF OF CALIFORNIA,
Scripps Institution of Oceanography, La Jolla, Calif; and California Univ., San Diego, La Jolla. Inst. of Marine Resources.
B. Zeitzschel.
Marine Biology, Vol 3, No 3, p 201-207, 1969. 3 fig, 2 tab, 33 ref.

Descriptors: *Primary productivity, *Water analysis, Photometry, Analysis, Light penetration, Phytoplankton, On-site tests, Laboratory tests, Ocean circulation.
Identifiers: *Carbon-14, *Research cruise, *Baja California, Submarine photometer, Upwelling, Tidal mixing, Gulf of California, Bay of Bengal, West African coast.

Primary productivity in the Gulf of California was investigated at 34 sampling stations during 6 cruises. Inoculation of water with carbon-14 at various depths and incubation for 1/2 a solar day revealed a considerably higher primary productivity than that of oceans at comparable latitudes. The Gulf exhibits four zones with mean values ranging from 0.272 grams carbon/square meter per day to 0.677 grams carbon/square meter per day. The average integrated rate of primary production from all stations is 0.382 grams carbon/square meter per day (0.002 to 0.932). This high productivity is comparable to that of the Bay of Bengal, the upwelling areas off the west coast of Baja California, or North Africa; it is two to three times greater than the productivity of open Atlantic or Pacific Oceans at similar latitudes. The recorded rate of primary productivity is in part due to seasonal upwelling down to shallow thermocline and to tidal mixing. (Wilde-Wisconsin)
W70-04374

LIFE ON A DYING LAKE,
Peter Schrag.
Saturday Review, p 19-21, 55-56, September 20, 1969. 3 photos.

Descriptors: *Lake Erie, *Great Lakes, *Eutrophication, *Water pollution, *Water pollution effects, Water pollution control, Water pollution sources, Water law, Recreation, Chlorination, Beaches.
Identifiers: *Lake Erie basin, Cuyahoga River (Ohio), Iron III, Ferric iron, Maumee River, Cleveland (Ohio).

A look at Lake Erie's pollution problems shows the conflicts between the social, economic, and political viewpoints. Erie has aged 15,000 years in the past 50 years, but the questions surrounding the cleanup concern resources, priorities, and the urgency, thus leaving the thirteen million people dependent on the lake in limbo. City sewers, industrial wastes, and runoff provide the input, while algae, low oxygen levels, smell, trash fish, river fire, and the necessity to chlorinate beaches are some results. There is fear that the Iron III compound keeping algae nutrients trapped on the lake bottom is being dissolved, which would result in sharply increased eutrophication if the nutrients are released. The cities have not corrected their sewage pollution before demanding that the states enforce anti-pollution standards, leaving federally conducted enforcement conferences to encourage the five lake-region states to commit themselves to remove 80% of the primarily detergent-oriented phosphates by waste treatment. Pollution law shows it's hard to demonstrate a connection between discharges and damages. 'Whose rights are affected', 'Whose environment is it', and 'Who controls the environment' are some of the basic questions approached. (Powers-Wisconsin)
W70-04375

SEASONAL TRENDS IN PHYSICOCHEMICAL FACTORS AND PLANKTON OF A FRESHWATER FISHPOND AND THEIR ROLE IN FISH CULTURE,
Madurai Univ. (India) Dept. of Zoology.
R. George Michael.
Hydrobiologia, Vol 33, No 1, p 144-160, 1969. 13 fig, 47 ref.

Descriptors: *Fish, *Ponds, *Physicochemical properties, Zooplankton, Phytoplankton, Crustaceans, Protozoa, Phosphates, Rotifers, Hydrogen ion concentration.
Identifiers: *India, Barrackpore (India), Fish culture.

A two-year study of seasonal variations in physicochemical properties was made on an 817.5 square meter freshwater pond. Water level varied from 1.9 to 2.6 meters depth, fluctuations due to alternate dry and monsoon seasons. Total alkalinity was inversely related to rainfall; phosphorus concentration was directly related to rainfall although modified by phytoplanktonic utilization. Range of temperature variation was about 19C; minima (14C) occurring in December, maxima (33C) occurring in June-July. Fluctuations in pH and dissolved oxygen did not conform to any seasonal trend. Carbon dioxide concentrations were directly correlated with amount and nature of biological activity. Protozoan populations were low except for peritrich ciliates in the second year of the study. Phytoplankton peaks (mainly flagellates) occurred in December to April; peaks of rotifer and planktonic crustacean populations occurred from February to April. Size of rotifer populations was correlated with high total alkalinity and temperature. Dissolved oxygen, carbon dioxide, and total alkalinity concentrations occur in ranges compatible with high fish yield. (Voigtlander-Wisconsin)
W70-04376

DISTRIBUTION OF CYANOPHAGES IN NATURAL HABITATS,
E. Padan, and M. Shilo.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 747-751, November 1969. 2 tab, 7 ref.

Descriptors: *Viruses, *Ecological distribution, Biocontrol, Water pollution, Cyanophyta, Aquatic habitats, Eutrophication, Lakes, Photosynthesis, Dialysis.
Identifiers: *Cyanophages, Lyngbya, Plectonema, Phormidium, Microbial ecology, Israel, Beith Shean (Israel), Fish ponds, Lake Kinnereth (Israel), Species specificity, Plectonema boryanum, Seasonal effects, Biotopes, Schizothrix calcicola, Plaque-forming-units assay.

First described in 1963, a virus which lyses cyanophytes (blue-green algae), called 'cyanophage' because of its similarity to bacteriophages, is highly specific for algal genera: Lyngbya, Plectonema, Phormidium. It is commonly found in sewage waters. Since then, viruses attacking other cyanophytes have been isolated. Distribution of the organisms in Israeli water sources, and their variations with fluctuations in host populations were studied. Filtered samples (3 liters) were concentrated to 10 milliliters by dialysis, and the dialysate passed through ultrafine filter which passes virus particles. Clearing of a growing algal culture, when incubated with ultrafiltrate, indicates presence of cyanophages; these can be assayed quantitatively by counting plaques, each resulting from a single virus particle, which are formed when test mixture is incubated with agar culture of algae. Five samples from Lake Kinnereth, and over 90% of 40 samples from fish ponds contained phages specific for Plectonema. In 5 ponds, concentrations of cyanophages were in 1-13,000 particles/liter range, peak concentrations corresponding with development of cyanophyte blooms. Susceptible algae are not always isolatable from aquatic habitats where virus is found. Numbers of cyanophate-sensitive algae and concentrations of their viruses are apparently in a state of dynamic equilibrium. (Eichhorn-Wisconsin)
W70-04377

BACTERIAL UPTAKE OF ORGANIC SUBSTRATE: NEW METHODS OF STUDY AND APPLICATION TO EUTROPHICATION,
North Carolina State Univ., Raleigh. Dept. of Zoology.
John E. Hobbie, and Claude C. Crawford.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 725-730, November 1969. 3 fig, 1 tab, 10 ref.

Descriptors: *Aquatic bacteria, *Organic matter, *Eutrophication, *Analytical techniques, Ecosystems, Aquatic habitats, Water pollution effects, Physiological ecology, Respiration, Carbon radioisotopes, Kinetics, North Carolina, Carbonates, Ponds, Regression analysis, Trophic level, Oliogotrophy, Lakes, Estuaries, Sewage effluents, Rivers.
Identifiers: *Heterotrophy, Microbial ecology, Carbon-14, Michaelis-Menten equation, Turnover times, Uptake velocities, Millipore filtration, Glucose, Raleigh (NC), Aspartic acid, Hypereutrophy, South Creek (NC), Pamlico River (NC), Relative heterotrophic activity, Scintillation counting.

Methods for application of Michaelis-Menten kinetics to estimate parameters in bacterial assimilation of radiocarbon-labeled organic solutes from natural waters, described earlier, underestimate heterotrophic potential because they fail to consider loss of radioactivity in respired carbon dioxide. These errors are substantial and must be accounted for. Methods are described which accomplish incubation in presence of radioactive substrate in closed vessels. Respired carbon dioxide is absorbed on phenylethylamine-saturated chromatographic paper. After incubation, plankton are filtered onto membrane filter (0.5 micron pore size). Carbon-14 of both filter and absorbing paper is assessed by liquid scintillation counting. As test of methods, water from a small dairy farm pond was incubated with added radioactive glucose and aspartic acid. Corrected data, fitted by computer to Lineweaver-Burk plots, yielded straight lines, indicating that a transport system is operational in uptake. Fit for corrected data is better than for uncorrected. With glucose, mean of 28.9% radioactivity was respired (range for 8 samples: 28.3-32.4%); with aspartic acid, as much as 63.8% is respired. The Wright-Hobbie analysis was previously applied to lakes. Data are presented to demonstrate its application to rivers. Glucose uptake is stimulated at points of introduction into an estuarine river of sewage effluents and wastes from phosphate-mining. (Eichhorn-Wisconsin)
W70-04379

SOME PROBLEMS REMAINING IN ALGAE CULTURING,
Station d'Hydrobiologie Appliquee, Le Paraclet par Boves (France).
A. G. Wurtz.
Algae and Man, Jackson, Daniel F (editor), Plenum Press, New York, p 120-137, 1964.

Descriptors: *Analytical techniques, *Algae, *Growth rates, *Bioindicators, *Water pollution, *Waste treatment, Food chains, Chlorella, Chlorophyll, Physiological ecology, Cyanophyta, Eutrophication, Nuisance algae, Nitrogen, Phosphates, Hydrogen ion concentration, Cycling nutrients, Mud-water interfaces, Euglenophyta, Toxicity, Bioassays, Diatoms, Euglena, Sphaerotilus.
Identifiers: *Algal cultures, *Axenic cultures, Pediastrum, Self-purification, Algal enumeration, Scenedesmus, Growth equations, Ankistrodesmus, Heterotrophy, Continuous cultures, Chlamydomonas, Batch cultures, Optical density, Soil-water techniques, Phycology, Microcystis, Glocotrichia, Aphanizomenon, Micronutrients, Dinophyceae, Cryptophyceae, Chromatium, Oscillatoria, Antibiotic treatment, Chu's medium, Ultraviolet sterilization, Constructive synecology, Tabellaria.

Numerous problems exist among the interfaces between pure-culture study of algae and phycological ecology, especially as regards the quality of man's environment. While attainment of axenic cultures is, of itself, a valid goal, increasing use of such cultures, coupled with ecological insights, may yield useful information pertaining to many perplexing practical problems. Equations describing relationships among growth, yield, and biomass in batch and continuous cultures are reviewed, as are methods for evaluating algal growth. There remains a basic need for standardized techniques for assessing growth in algal cultures. Some aspects of techniques for axenic culturing are reviewed. Discrepancies between information on mineral nutrition of blue-green algae, as developed from studies of axenic cultures, and field observations of conditions leading to nuisance blooms need further study and clarification. The soil-water technique, which has been instrumental in successful culturing of some 500 strains of various algae, raises further ecological questions, including those of heterotrophy and conditions at the soil-water interface. Other similar questions considered in some detail in this report include influence of innoculum size on population growth; ecological implications of algal culture; self-purification of wastes by algae; algal indicators of water quality; and role of algae in food chains. (See Vol. 2, No. 19, Field 5C, W69-07832). (Eichhorn-Wisconsin)
W70-04381

EFFECTS OF ENRICHMENT IN MATHEMATICAL MODELS,
Michigan Univ., Ann Arbor.
Frederick E. Smith.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. p 631-645. 5 fig.

Descriptors: *Eutrophication, *Mathematical models, *Systems analysis, Water pollution effects, Ecosystems, Simulation analysis, Analytical techniques, Computer models, Trophic level, Aquatic populations, Cycling nutrients, Food webs, Productivity, Predation, Herbivores, Aquatic plants, Organic matter, Growth, Numerical analysis, Detritus, Stochastic processes, Digital computers.
Identifiers: *Enrichment, IBM 7090, Michaelis-Menton equation, Feeding ability, Growth capacity, Inherent losses, Conversion efficiency, Decomposers, Nutrient limitation, Energy limitation, Rutte-Kunga methods, Rate processes.

Ecosystems are as complex as other highly intricate systems which have been adequately modeled, although levels of interest and resources in ecology may be inadequate to attain such modeling. Systems analysis does not require complete models, simplified versions often yielding meaningful insights into operation of dominant influences in actual systems. Simplified ecosystems of 3 or 4 trophic levels and a nutrient pool are describably by models which consider feeding ability, growth capacity, inherent losses, and conversion efficiency. Model for 3 populations has 12 parameters; that for 4, has 17. Models are analogous with Michaelis-Menton equation describing enzyme-saturation kinetics. Development of equations characterizing rate processes, into which stochastic processes were introduced, permitted systems simulation on computer (IBM 7090). Simulations suggest that effects of eutrophication may be systems effects which are independent of species composition, and that some accepted ecological concepts are challengeable. Behavior of models raises important ecological implications including--among others: Parameters in addition to those considered here control ecosystem stability, since population growth tends to cause oscillation to extinction; derivation of food-web stability from diversity is not supported; enrichment of system with mineral nutrients can cause flora to change to a less nutritious type. (See Vol. 3, No. 10, Field 5C, W70-03975). (Eichhorn-Wisconsin)
W70-04383

EVALUATING NUTRIENT SUPPLIES FOR THE GROWTH OF AQUATIC PLANTS IN NATURAL WATERS,
Wisconsin Univ., Madison. Dept. of Botany.
G. C. Gerloff.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. p 537-555. 4 fig, 8 tab, 32 ref.

Descriptors: *Nutrient requirements, *Aquatic plants, *Water, Lakes, Streams, Carbon radioisotopes, Nitrogen, Phosphorus, Indicators, Soils, Bioassay, Surfaces, Iron, Nitrates, Phosphates, Chemical analysis, Wisconsin, Cultures, Trace elements, Hydrogen ion concentration, Cyanophyta.
Identifiers: *Growth, Tissue analysis, Index tissues, Critical concentration, Field-plots, Microcystis aeruginosa, Lake Mendota (Wis), Physiological age, Vallisneria americana, Ceratophyllum demursum, Heteranthera dubia, Elodea occidentalis, Lake Monona (Wis), Najas flexilis, Zannichelia palustris, Lake Waubesa (Wis), Potamogeton.

No procedure for evaluating nutrient supplies and detecting growth-limiting factors in lakes and streams has been developed for general reliability and usefulness. The tissue-analysis procedure gives promise of being very useful in studies of aquatic environments. In an single analytical value, it provides for an integrated expression of availabilities of an element in various parts of a lake or stream from which an organism absorbed nutrients during growth. Many of sampling problems associated with the continual movement and shifting of the aquatic environment thus can be minimized. Enrichment cultures using carbon-14 to measure photosynthetic and biological activity appear somewhat more complex than tissue analysis. Among the problems in need of immediate study are: determining the most appropriate plant parts to sample and analyze; whether analysis for the total content of each element or for an extracted fraction more reliably correlates with yield; the critical concentrations for various species; whether certain species are particularly reliable indicators of water fertility--whether they would serve as indicator plants; the most reliable procedures for collecting plant samples in a particular body of water; the critical concentrations of essential elements, other than nitrogen and phosphorus, in several of the most important aquatic species. (See Vol. 3, No. 10, Field 5C, W70-03975). (Jones-Wisconsin)
W70-04384

GEOCHEMISTRY OF EUTROPHICATION,
General Dynamics Corp., Groton, Conn. Electric Boat Div.
Richard J. Benoit.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. p 614-630. 3 fig, 6 tab, 30 ref.

Descriptors: *Geochemistry, *Eutrophication, *Water structure, Atmosphere, Sea water, Fresh water, Sorption, Sodium, Algae, Phosphorus, Trace elements, Plankton, Lakes, Rivers, Great Lakes.
Identifiers: *Equilibrium model, Lithosphere, Sorption reactions, Solubility equilibrium theory.

The tendency of the land-based hydrosphere to attain similar composition under the combined influences of the buffering action of ion-exchange reactions and integration of tributaries is stressed. The equilibrium model, based on solubility equilibria of common constituents of the lithosphere and carbon dioxide concentration equal to 35,000 atmospheres, gives a reasonably satisfactory agreement with the actual composition of water of the Great Lakes. While sorption reactions may cause some deviations from the equilibrium models, the major discrepancies in the chemical composition of waters are attributed to man's activity. This is particularly true of the contents of sodium and phosphorus, the two elements that may limit or unduly promote the algal growth. Trace

elements may also alter the trophic level of a lake to create a nuisance or even lead to a degradation of a resource. (See Vol. 3, No. 10, Field 5C, W70-03975). (Wilde-Wisconsin)
W70-04385

NUTRIENTS IN THE POTOMAC RIVER BASIN,
New York State Department of Health, Albany. Div. of Environmental Health Services.
Norbert A. Jaworski, Orterio Villa, Jr., and Leo J. Hetling.
FWPCA, Chesapeake Technical Support Laboratory, Technical Report No 9, May 1969. 40 p, 15 fig, 5 tab, 8 ref.

Descriptors: *Nutrients, *Eutrophication, *River basins, Agricultural wastes, Phosphates, Phosphorus compounds, Nitrogen compounds, Streamflow, Land use, Surface runoff, Mathematical models, Estuaries, District of Columbia, Chlorophyll, Regression analysis, Chlorella, Pennsylvania, Chlamydomonas, Maryland, Cyanophyta, West Virginia, Chlorophyta, Virginia, Biomass, Sampling, Nutrient cycling, Industrial wastes, Nitrites, Nitrates, Ammonia, Water pollution.
Identifiers: *Potomac River, Urban runoff, Seasonal effects, Washington (D C), Chlorophyll a, Predictive equations, Algal blooms, Anacystis, Water quality management, Sub-basins, Hydrographs, Isopleth diagrams, Nitrogen forms, Phosphorus forms, Nutrient loading.

The Potomac River system drains some 14,670 square miles of forested, agricultural, industrialized, and urbanized areas, in December 1968 receiving 382 known discharges. Basinwide studies were undertaken of water quality management, emphasizing eutrophication. In 1966, these studies yielded following estimates of average nutrient loading (in pounds/day) to surface waters of Potomac: phosphorus as phosphate (phosphate-P) --94,130; total nitrogen as nitrogen (N) --122,190. Of these loadings, 87% of phosphate-P and 53% of N originates as wastewater discharges. Inorganic N increases, P decreases with increased streamflow in non-tidal waters. Algal blooms, as indicated by concentrations of chlorophyll a, greater than 50 micrograms/liter were observed over 50 miles of upper Potomac estuary during June-October 1968. During months of decreased flow, high concentrations of total Kjeldahl N, nitrates and phosphates in upper estuary are principally attributable to wastewater discharge from District of Columbia metropolitan area. Studies of mass balance and transport, utilizing predictive equations, demonstrate that at steady state flows, 38% of P entering surface waters of upper basin are retained in channel, apparently in sediments and plants. Stability of such retention is not known. (Eichhorn-Wisconsin)
W70-04386

GALVESTON BAY: TEST CASE OF AN ESTUARY IN CRISIS,
Luther J. Carter.
In: Science, Vol 167, No 3921, p 1102-8, Feb 20, 1970. 1 fig.

Descriptors: *Estuarine environment, *Estuaries, *Landfills, *Diversion, *Water pollution, Marshes, Shellfish, Fishkill, Thermal pollution, Industrial wastes, Municipal wastes, Water demand, Water supply, Waste treatment, Inter-agency cooperation, Political aspects, Water zoning, Land use, Urbanization, Waste assimilative capacity.
Identifiers: *Galveston Bay, *Galveston, *Houston, *Houston Ship Channel, *Houston Lighting and Power Company, *Water Quality Board, *Gulf Coast Waste Disposal Authority, *Shelldredging, *U.S. Army Corps of Engineers, *Effluent standards, Texas Water Development Board, Texas Water Plan.

The Galveston Bay estuary's environmental crisis is reported. Long a major nursery area for shellfish and finfish, the bay's water quality has been severely degraded by rapid industrial and population growth. A 1914 decision to build the Houston Ship Channel has had far-reaching environmental effects. The industries and residential subdivisions which have grown up along the channel, dump raw sewage into it. This highly polluted water flows untreated into the Bay. Shelldredging, water diversions and landfill encroachments have severely reduced the nursery marshlands and increased salinity. The U.S. Corps of Engineers proposed Wallisville Dam will further aggrevate these situations, threatening estuarial life. The Houston Lighting and Power Company's new facility will add thermal pollution to the Bay's problems. Traditionally, the Texas state government has been insensitive to the water pollution problems of the state's few industrial-oriented municipalities. Thus, state water quality standards are low, but federally approved, and have never been enforced. The recent federal activity has prompted the hitherto dormant State Water Quality Board to take the offensive for the first time in its history, and the establishment of the Gulf Coast Waste Disposal Authority as a coordinating agency. (Richmond-Chicago)
W70-04432

PRIMARY PRODUCTION AND NUTRIENTS IN OGAC LAKE, A LANDLOCKED FIORD ON BAFFIN ISLAND,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
For primary bibliographic entry see Field 02H.
W70-04446

INFLUENCE OF MARINE PROTOZOA ON NUTRIENT REGENERATION,
Georgia Univ., Sapelo Island. Marine Inst.
R. E. Johannes.
Limnology and Oceanography, Vol 10, No 3, p 434-442, 1965. 4 fig, 2 tab, 34 ref.

Descriptors: *Marine animals, *Protozoa, *Nutrients, Phosphorus, Phosphate, Microorganisms, Crustaceans, Detritus, Bacteria, Phosphorus radioisotopes, Sewage, Georgia, Mud, Tidal waters, Sands, Beaches, Radioactivity, Tracers, Mussels, Grazing, Copepods, Diatoms, Benthos, Interfaces, Salt marshes, Continental shelf, Plankton, Nematodes, Hydrogen ion concentration.
Identifiers: *Regeneration, Macrofauna, Excretion, Ciliates, Flagellates, Uptake, Euplotes crassus, Euplotes vannus, Euplotes trisulcatus, Uronema, Spartina alterniflora, Sapelo Island (Ga), Dissolved phosphorus, Modiolus demissus.

High concentrations of ciliates and other protozoa are characteristic of decomposing sewage. Water bodies containing living organisms produce natural 'sewage' in form of dead organisms, feces, and dissolved metabolites. Per unit weight, marine protozoa excrete dissolved phosphorus one to two orders of magnitude faster than marine microcrustaceans and several orders of magnitude faster than marine macrofauna. Protozoa may be responsible for a major fraction of faunal nutrient excretion even though only present as a minor fraction of the faunal biomass. Regeneration of dissolved inorganic phosphate from organic detritus proceeds faster and more completely in the presence of bacteria and ciliates or colorless flagellates than in the presence of bacteria alone. An increased consumption of organic detritus in the presence of protozoa is performed by bacteria, which are kept in a prolonged state of 'physiological youth' by grazing protozoa. Present results indicate that it is the protozoa that produce, via excretion, the greater regeneration of nutrients from organic detritus. By constituting a nutrient source for protozoa, bacteria are indirectly involved in the increased regeneration. Bacterial activities greatly influence the pH of sediments and of bodies of water where circulation is restricted. (Jones-Wisconsin)
W70-04447

COMPOSITION AND NUTRITIVE VALUE OF FECAL PELLETS OF A MARINE CRUSTACEAN,
Georgia Univ., Sapelo Island. Marine Inst.
R. E. Johannes, and Masako Satomi.
Limnology and Oceanography, Vol 11, No 2, p 191-197, 1966. 2 fig, 2 tab, 27 ref.

Descriptors: *Chemical analysis, *Nutrients, *Marine animals, *Crustaceans, Ecosystem, Shrimp, Diatoms, Organic matter, Proteins, Bacteria, Light, Georgia, Microorganisms, Energy transfer, Herbivores, Carbon, Carbohydrates, Lipids, Phosphorus, Respiration, Ultraviolet radiation, Entropy, Detritus, Estuaries, Phytoplankton, Zooplankton.
Identifiers: *Fecal pellets, Palaemonetes pugio, Nitzschia closterium, Sapelo Island (Ga), Gastropods, Fundulus heteroclitus, Nassa obsoleta, Uca pugnax, Pagurus longicarpus, Autolysis, Solution, Euphotic zone.

The role of feces in energy flow and nutrient cycles in the marine ecosystem was examined using fecal pellets of the shrimp Palaemonetes pugio, fed on the diatom Nitzschia closterium. P pugio is extremely abundant in tidal creeks along the Georgia coast. The pellets were rich in organic matter, particularly protein and readily eaten by P pugio when diatoms were not available and assimilation efficiency was high, indicating that the pellets contained substantial absorbable organic matter. Solution and bacterial respiration reduced the organic content of feces while light and dissolved organic matter stimulated the growth of autotrophic and heterotrophic microorganisms. It is estimated that the incorporation rate of organic matter into fecal pellets exceeds the incorporation rate of organic matter into herbivore tissue and that fecal pellets constitute a major potential food source for marine animals. If fecal pellets were to sink quantitatively out of the euphotic zone, the result would be a rapid removal of large quantities of phosphorus from the upper waters. Results suggest two ways in which this loss is minimized: solution of fecal phosphorus and ingestion of fecal pellets and assimilation of phosphorus by zooplankton. (Jones-Wisconsin)
W70-04448

ANNUAL CYCLE, SPECIES DIVERSITY AND SUCCESSION OF PHYTOPLANKTON IN LOWER SARONICOS BAY, AEGEAN SEA,
Democritus Nuclear Research Center, Athens, Greece. Hydrobiology Group.
L. Ignatiades.
Marine Biology, Vol 3, No 3, p 196-200, 1969. 1 fig, 3 tab, 6 ref.

Descriptors: *Cycles, *Succession, *Phytoplankton, Sampling, Diatoms, Light intensity, Phosphates, Grazing, Dinoflagellates, Seasonal, Nutrients, Population, Nitrates, Silicates, Turbulence, Primary productivity, Columns, Stratification.
Identifiers: *Saronicos Bay (Aegean Sea), Diversity index, Asterionella, Asterolampra, Asteromphalus, Bacteriastrum, Biddulphia, Chaetoceros, Cerataulina, Coscinodiscus, Dactyliosolen, Ditylum, Eucampia, Hemiaulus, Leptocylindrus, Licmophora, Nitzschia, Rhabdonema, Rhizosolenia, Skeletonema, Streptotheca, Thalassionema, Ceratium, Thalassiosira, Thalassiothrix, Amphisolenia, Dinophysis, Exuviella, Peridinium.

Annual cycles of diatoms and dinoflagellates in the lower Saronicos Bay, Aegean Sea, are described on the basis of net samples collected during 1967. The annual cycle is largely due to changes in diatom concentrations (cells/liter), while the dinoflagellate concentrations remain constant. A pronounced spring diatom bloom is followed by a quantitative and qualitative decline of diatoms in summer due mainly to high light intensities, phosphorus depletion and extensive grazing. Autumnal diatom increase lasts during the rest of the year; the phase of small diatoms develops incompletely. The theoretical model of species succession is affected by poor

nutritional conditions of the bay. Low species diversity levels prevail during the spring phytoplankton bloom; diversity increases in later succession stages. Results do not suggest any clear limiting effect of nitrate and silicate concentrations on phytoplankton abundance. Dinoflagellates formed a constant component of the plankton at all seasons, but were characterized by their sparsity. The two observed maxima did not total more than 400 cells/liter; in summer and early autumn their occurrence was 20-100 cells/liter. The population was dominated by the Ceratium community throughout the year. (Jones-Wisconsin)
W70-04450

EFFECTS OF CONTROLLED NUTRIENT DILUTION OF A EUTROPHIC LAKE,
Seattle, Wash.
Ray T. Oglesby.
Water Research, Vol 2, p 106-108, 1968. 2 fig, 5 ref.

Descriptors: *Eutrophication, *Lakes, *Nutrients, Recreation, Washington, Cyanophyta, Chlorophyll, Phosphates, Nitrates, Phytoplankton, Primary productivity, Water quality, Standing crop, Alkalinity, Sodium, Molybdenum, Nitrogen fixation.
Identifiers: Green Lake (Wash), Flushing, Transparency, Dilution, Aphanizomenon holsaticum, Flos-aquae, Anacystis, Gleotrichia echninulata, Anabaena circinalis, Dilution water, Seattle (Wash).

Green Lake, located near the center of Seattle, Washington, has an intensive recreational use and represents a valuable resource. To prolong the life of this body of water to improve its quality, large quantities of nutrient-poor water were diverted from the city's potable supply through the lake. In determining the effectiveness of this program, Green Lake has been sampled at least once each month during the winter and two to four times per month during the rest of the year, during a three year period. Chief emphasis has been placed on variations in nutrient levels, transparency, presence of phytoplankton species and primary production levels as related to the addition of large volumes of dilution water. Although the pattern is complex, the trend toward improved conditions is definite. Two postulates are advanced for the decreased eutrophication resulting from the flushing: decrease in availability of primary nutrients, and a decrease in the overall mineral content to a very low level resulting in algal species changes and primary production limitations due to trace element deficiences. Concentrations of nitrate indicate an apparent correlation with the very high productivity peaks exhibited in 1959. (Jones-Wisconsin)
W70-04451

PRELIMINARY STUDIES ON PRIMARY PRODUCTIVITY AT PAYAKONDA, GULF OF KANDALAKSHA, WHITE SEA,
Akademiya Nauk SSSR. Institut Okeanologii.
K. Radhakrishna.
Marine Biology, Vol 3, No 2, p 188-190, 1969. 1 fig, 2 tab, 14 ref.

Descriptors: *Tidal effects, *Tides, *Primary productivity, Phytoplankton, Photosynthesis, Nitrate, Oxygen, Analysis, Light intensity, Insulation, Phosphate.
Identifiers: *High tides, *Low tides, White Sea, Kandalaksha Gulf, Payakonda (White Sea), High Venice Lagoon (Italy), Beaufort Channel.

The primary production in the near-shore, shallow part of the Gulf of Kandalaksha was investigated during late summer by the light and dark bottle method and the use of carbon-14. Sampling of water was confined to the surface and 3-meter depth. Oxygen samples were exposed to light for 24 hours; carbon-14 samples, for 6 hours. Surface insulation was determined with a pyrheliometer and subsurface insulation by a submarine photometer. Radioactivity was measured by an end-window Geiger counter. The oxygen determinations of photosynthesis were about three times as high as those obtained with carbon-14 values. In spite of restricted light penetration to the 3 meter depth, the rate of production in milligrams carbon/cubic meter per day was high. Low tide waters had a higher concentration of nutrients and growth stimulating effect than high tide waters. (Wilde-Wisconsin)
W70-04454

THE FUTURE OF THE LAKE,
Washington Univ., Seattle. Dept. of Zoology.
W. T. Edmondson.
Municipality of Metropolitan Seattle, Metro Quarterly, Fall 1965. 4 p, 1 fig.

Descriptors: *Algae, *Water pollution treatment, Lakes, Sewage, Drainage districts, Debt, Costs, Cities.
Identifiers: *Lake Washington (Wash), Seattle (Wash), Revenue bonds, Metro Act (Seattle).

Originally Seattle, Washington, released non-treated sewage into Puget Sound and treated sewage into Lake Washington. Swimming in the sound was destroyed, and Lake Washington became eutrophic. The Metro Act enacted in 1957 provided for the establishment of a metropolitan municipal corporation with the power to perform sewage disposal, water, parks, transportation, comprehensive planning and/or garbage disposal. In 1958 the sewage disposal proviso was approved by 60% vote. July 1966 should see the end of sewage discharge into Lake Washington. $120 million in revenue bonds have been sold to date, to be repaid by a $2 monthly charge per residential connection and a $2 monthly charge per 900 cubic feet of water used by industrial and commercial enterprises. Prompt improvement in the lake is expected within a few years after final diversion in 1966 as the watershed is relatively poor in dissolved minerals including nutrients needed by algae, and as there are no massive deposits of accumulated soft sediments on the lake bottom rich in nutrients available to algae, the prognosis is good for the recovery of Lake Washington. (Powers-Wisconsin)
W70-04455

EUTROPHIC EFFECTS AT THE MOUTH OF A GREAT RIVER (GRAND RHONE) (IN FRENCH),
Centre d'Oceanographie, Marseille (France). Station Marine d'Endoume.
F. Blank, M. Leveau, and K. H. Szekielda.
Marine Biology, Vol 3, No 3, p 233-242, 1969. 19 fig, 4 tab, 13 ref.

Descriptors: *Eutrophication, *Rivers, Salinity, Temperature, Nutrients, Gulfs, Phytoplankton, Zooplankton, Chlorophyll, Seston, Organic matter, Brackish water, Fresh water, Sampling, Phosphates, Nitrates, Biomass, Fish, Winds, Precipitation (Atmospheric), Currents (Water), Marine plants, Benthic flora, Dinoflagellates, Diatoms, Copepods, Mollusks, Crustaceans, Chordates.
Identifiers: *Mouth, *Rhone (France), Mediterranean Sea, Marseilles (France), Port Saint-Louis (France), Coriolis (France), Provence (France), Chaetoceros curvisetus, Nitzschia closterium, Radiolaria, Tintinnida, Cladocerans, Paracalanus parvus, Acartia clausi, Centropages typicus, Evadne spinifera, Podon polyphemoides, Coelenterata, Chactognathes, Decapod larvae, Penilia avirostris, Conchoecia spinirostris, Creseis acicula.

A study of hydrographical and biological parameters in surface waters near the mouth of the Rhone River was made. Salinity, temperature and nutrient salts have been recorded, and phytoplankton, together with zooplankton, quantitatively and qualitatively analyzed. Chlorophyll a, seston, and organic matter concentration had been determined. The hydrographical structure near the Rhone is heterogenous and biological results are difficult to explain on the basis of hydrographical parameters. The numerical data of zooplantkton in the area are 10 times higher than in the Mediterranean Sea. Major composition of zooplankton is copepods and cladocerans, with Paracalanus parvus and Acartia clausi the dominant species. There is a great abundance of brackish and fresh water phytoplankton in the dilution zone, but these cells are dead or almost dead, coinciding with the low concentrations of chlorophyll a. The temperature and salinity show the hydrologic complexity. The Rhone's fresh water runs into neritic water, influencing a strong dilution zone on both sides of the main current, gradient being stronger at the east than west. Line of demarcation between the zones is a veritable frontier where the salinities quickly change from 10 to 37 parts/thousand. (Jones-Wisconsin)
W70-04460

MYCOLOGICAL INVESTIGATIONS OF THE BLACK SEA,
Miami Univ., Fla. Inst. of Marine Science; and Miami Univ., Fla. Dept. of Microbiology.
Samuel P. Meyers, Donald G. Ahearn, and Frank J. Roth, Jr.
Bulletin of Marine Science, Vol 17, No 3, p 576-596, 1967. 5 fig, 3 tab, 21 ref.

Descriptors: *Investigations, Yeasts, Molds, Density, Depth, Fungi, Sampling, Hydrography, Atlantic Ocean, Indian Ocean, Thermocline, Hydrogen sulfide, Distance, Sedimentation.
Identifiers: *Mycological, *Black Sea, Debaryomyces hansenii, Candida diddensii, Rhodotorula, Rhodotorula glutinis, Hyphomycetes, Cladosporium herbarum, Cladosporium cladosporioides, Aureobasidium pullulans, Physiological characteristics, Morphology, Current boundaries, Hansenula jadinii, Cryptococcus, Torulopsis, Sporobolomyces, Taphrina, Alternaria, Aspergillus, Nigrospora sphaerica, Fusarium oxysporum, Cephalosporium, Papularia sphaerosperma.

The Black Sea basin, generally devoid of vertical equalizing currents, is characterized by a decrease in oxygen with increasing depths. Its peculiar hydrochemical nature makes it an excellent locale for evaluation of distribution parameters and activity of specific fungal taxa. A collection of 558 molds and yeasts from the Black Sea has been characterized and population densities established. Of 174 water samples taken, 84 were positive for yeasts, while 97 contained molds. Average yeast density was less than 10 cells/liter while densities in excess of 20 cells/liter were found in only six samples. The maximal yeast population was 150 cells/liter. Decrease in incidence, density, and average number of yeast species was noted with increasing depth. Predominant taxa included the yeasts, Debaryomyces hansenii, Candida diddensii, Rhodotorula rubra, and Rhodotorula glutinis, and the hyphomycetes, Cladosporium and Aureobasidium pullulans. Generally, low concentrations of fungi prevented definitive correlation of individual species distribution with hydrographic aspects. Comparison of data with those obtained in earlier yeast studies in the Black Sea suggests that the previous information, and generalizations derived therefrom, must be critically re-evaluated. (Jones-Wisconsin)
W70-04461

CHANGES IN METAL COMPOSITION OF THE QUAHAUG CLAM, MERCENARIA MERCENARIA, AFTER EXPOSURE TO INSECTICIDES,
Bureau of Sport Fisheries and Wildlife, Highlands, N.J. Fish-Pesticide Research Lab.
Ronald Eisler, and Melvin P. Weinstein.
Chesapeake Science, Vol 8, No 4, p 253-258, 1967. 2 fig, 2 tab, 18 ref.

Descriptors: *Metals, *Insecticides, *Water pollution effects, Organophosphorus pesticides, Chemical analysis, Sodium, Potassium, Magnesium, Iron, Calcium, Zinc, Bioindicators, Environmental effects, Clams, Estuaries, Physiological ecology, New

Jersey, Bioassays, Toxicity, Fish, Crustacea, Trace elements.
Identifiers: *Chemical composition, *Quahaug clam, *Mercenaria mercenaria, Methoxychlor, Malathion, Organochloride pesticides, Raritan Bay (NJ), Anguilla, Fundulus, Mugil, Sphaeroides, Menidia, Palaemonetes, Crangon, Pagurus.

Estuarine faunas are particularly susceptible to deleterious effects of chemical pesticides because such compounds, disseminated from drainage systems, tend to accumulate in estuaries. A variety of pesticide-induced disturbances of physiology and behavior have been demonstrated for various marine organisms. Adult quahaug clams were subjected to graded concentrations of insecticides, Malathion (organophosphorus) and methoxychlor (organochloride), for 96 hours under standardized conditions (24/mill salinity; 20C; aeration; daily light cycle: 10 hours at 25 foot-candles, 14 hours darkness). Clams appeared normal at highest concentrations (parts/billion) tested: Malathion--37,000; methoxychlor--1,100. Quahaugs are more resistant to these insecticides than are many marine fishes and crustaceans, for which toxicity data are presented. Exposed clams, removed to uncontaminated medium, survived at least 133 days post-exposure, apparently unaffected by treatment. Metallic composition of whole animals and selected tissues (gill, mantle, muscle) were analyzed by atomic absorption spectrophotometry. Profiles, presented as shifts in composition, between control and experimental animals, as function of pesticide dose, indicate changes in sodium, potassium, magnesium, iron, and marked changes in calcium and zinc. Such profiles may provide means of identifying unfavorable environmental effects before more drastic changes occur. Disproportionate changes in metallic composition of clams need further study. (Eichhorn-Wisconsin)
W70-04462

OUTWITTING THE PATIENT ASSASSIN: THE HUMAN USE OF LAKE POLLUTION,
Northwestern Univ., Evanston, Ill. Technological Inst.
Harold B. Gotaas.
Bulletin of the Atomic Scientists, p 8-10, May 1969.

Descriptors: *Nutrients, *Benefit-cost analysis, *Lake Erie, Phosphorus, Fish stocking, Commercial fish, Salmon, Algae, Fish.
Identifiers: Antipollution programs, Biological balance, Overfishing, Coho salmon, Alewife, Nutrient removal.

Some aspects of the October 1968 Department of Interior report on Lake Erie are challenged. The emphasis on nutrient removal which would result in immediate expenditure of $1.1 billion to control municipal pollution and $285 million for curbing industrial contamination is questioned in light of the expected benefits. Several efficacious alternatives for reviving the Great Lakes are suggested: (1) further nutrient relationships and cost versus benefits studies should be undertaken before money is spent to build expensive treatment facilities; (2) harvest algae as a potential source of food thus preventing it from contributing to the organic waste load; (3) prevent the introduction of all toxic materials enabling desirable biological balances to be established; (4) seed the lakes with desirable fish to establish a food chain which would permit the growth and removal of nutrients as well as fish for food needs and sport; and (5) adopt water quality standards that are realistic as to their costs, benefits, and time priorities. (Haskins-Wisconsin)
W70-04465

THE ROLE OF CULTURED POND FISH IN THE CONTROL OF EUTROPHICATION IN LAKES AND DAMS,
Fish Culture Research Training Inst., Malacca (Malaysia).
G. A. Prowse.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 714-718, 1969. 15 ref.

Descriptors: *Eutrophication, *Fish farming, *Lakes, *Impoundments, *Water pollution control, Cyanophyta, Fish, Aquatic plants, Herbivores, Environmental effects, Fertilization, Phosphates, Diatoms, Chlorophyta, Nitrogen, Tropical regions.
Identifiers: Helostoma temmincki, Mugil, Hypophthalmichthys molitrix, Tilapia mossambica, Macrophytes, Tilapia zillii, Tilapia melanopleura, Ctenopharyngodon idellus, Grass carp, Lemna, Spirodela, Eichhornia, Pistia, Salvinia, Sedges, Melacca (Malaysia), Malaya, Anabaena inaequalis, Anabaenopsis raciborskii, Anabaena flos-aquae, Anabaena spiroides, Microcystis aeruginosa, Silver carp, Calothrix, Aphanizomenon flos-aquae, Oscillatoria, Oedogonium, Planktophage fishes, Ceratium.

Less desirable enrichment effects of the hydrosphere with plant nutrients include excessive growths of various aquatic macrophytes, and of algae, usually blue-greens. In certain situations, introduction of cultured pond fishes offers a means of controlling those manifestations of eutrophication. Criteria for suitable candidates include: (1) fish should be planktophagous or herbivorous; (2) they should not create a nuisance by spreading; (3) they must co-exist peacefully with other species without detriment to latter; (4) they must maintain their numbers in face of predation; and (5) they must tolerate existing temperature conditions. Among suitable choices of macrophyte-feeders are Tilapia zillii, T melanopleura, and the grass carp, Ctenopharyngodon idellus. Tilapia will not tolerate temperatures below 10C, but are very fecund under tropical conditions. Ctenopharyngodon has wide temperature tolerance, but its spawning must be induced artificially with pituitary injections. Suitable planktophages include Tilapia mossambica and related species, and silver carp, Hypophthalmichthys molitrix. These Tilapia do not thrive below 13C, but spawning of silver carp is easier than with Ctenopharyngodon. Combinations of planktophages and herbivores are often desirable. In eutrophic brackish lakes, like Lake Onondaga, New York, various mullets (Mugil) might be suitable planktophages. (Eichhorn-Wisconsin)
W70-04467

ALGAE FROM WESTERN LAKE ERIE,
Ohio State Univ., Columbus. Dept. of Botany and Plant Pathology.
Clarence E. Taft, and W. Jack Kishler.
Ohio Journal of Science, Vol 68, No 2, p 80-83, 1968. 9 fig, 7 ref.

Descriptors: *Algae, *Lake Erie, Chlorophyta, Cyanophyta, United States, Habitats.
Identifiers: *New species, *Western Lake Erie (Ohio), Gongrosira stagnalis, Nephrocytium obesum W and G S West, Radiococcus nimbatus, Uronema elongatum Hodgetts, Chroococcus prescottii, Calothrix fusca, Microcoleus lacustris (Rab) Farlow, Cladophora, Taxonomic descriptions, Gongrosira lacustris Brand, Gongrosira debaryana Rab, Oocystis, Oscillatoria, Ulothrix, Eucapsis alpina Clements and Schantz, Scytonema alatum (Carm) Borzi, Scytonema myochrous.

Four species of algae in the Chlorophyta (Gongrosira stagnalis, Nephrocytium obesum, Radiococcus nimbatus, and Uronema elongatum) and five in the Cyanophyta (Chroococcus prescotti, Calothrix fusca, Microcoleus lacustris, Scytonema alatum, and Scytonema myochrous) are newly reported for western Lake Erie. Gongrosira stagnalis (G S West) Schmidle, collected from the basal fragments of old Cladophora, appears to be a new record for the United States. Nephrocytium obesum W and G S West, which is reported as often having a shallowly scrobiculate wall, is unique and merits further intensive study. These new algae occasionally appear in teaching and research collections at Stone Laboratory, Put-in-Bay, Ohio. The habitat of G stagnalis on calcium-encrusted Cladophora filaments is unique. (Jones-Wisconsin)
W70-04468

HEMATOLOGICAL ASPECTS OF THE THERMOACCLIMATORY PROCESS IN THE RAINBOW TROUT, SALMO GAIRDNERI,
Marquette Univ., Milwaukee, Wis. Dept. of Biology.
Mary Anne DeWilde, and A. H. Houston.
Journal, Fisheries Research Board, Canada, Vol. 24, No. 11, p. 2267-2281, Nov. 1967. 2 fig., 2 tab., 31 ref.

Descriptors: *Temperature, *Oxygen demand, *Acclimatization, *Rainbow trout, Fish.
Identifiers: Erythrocyte abundance, Hemoglobin concentrations, Mean erythrocytic volume and hemoglobin content.

The blood oxygen capacity of the rainbow trout has been investigated as a function of thermal acclimation in terms of erythrocyte abundance, packed cell volume, hemoglobin concentrations, and mean erythrocytic volume and hemoglobin content. Fish at the lower acclimation temperatures employed (3 deg, 7 deg C) were characterized by relatively low erythrocyte counts, hematocrits, and hemoglobin levels. Mean erythrocyte volumes tended to be relatively high, whereas mean erythrocytic hemoglobin content was somewhat below that typical of the higher temperature groups. In general, animals held at intermediate temperatures (11 deg, 14 deg, 17 deg C) showed significant increases in oxygen-carrying capacity by comparison with cold-acclimated fish. Finally, trout at 21 deg C typically had larger numbers of somewhat smaller red cells, more hemoglobin, and higher levels of hemoglobin per erythrocyte than either the lowor intermediate-temperature fish. Significant differences were observed between summer and fall-winter series of trout, particularly with respect to hemoglobin levels. The results do not indicate that modification in blood oxygen capacity are of major importance in the solution of the temperature-oxygen demand problem. However, there is support for the suggestion that hematological responses which do occur take place in approximately stepwise fashion. (Speakman-Vanderbilt)
W70-04470

THE EFFECT OF IMPOUNDMENTS ON NATURAL WATERS (IN GERMAN),
Akademiya Nauk SSSR, Leningrad (USSR).
For primary bibliographic entry see Field 02H.
W70-04475

TEMPERATURE CONTROL OF RESERVOIR RELEASES INTO NOLIN AND BARREN TAILWATERS,
Department of Fish and Wildlife Resources, Ky.
For primary bibliographic entry see Field 02H.
W70-04478

TREATMENT OF ALGAE AND WEEDS IN LAKES AT MADISON,
Health Dept., Madison, Wis. Lab.
For primary bibliographic entry see Field 02H.
W70-04494

THE BOTTOM FAUNA OF LAKE VATTERN, CENTRAL SWEDEN, AND SOME EFFECTS OF EUTROPHICATION,
For primary bibliographic entry see Field 02H.
W70-04495

THE ECOLOGICAL DECLINE OF LAKE ERIE,
New York State Coll. of Agriculture, Ithaca.
For primary bibliographic entry see Field 02H.
W70-04496

INFLUENCE OF POLLUTION ON THE BOTTOM FAUNA OF THE SOUND (ORESUND),
Lund Univ. (Sweden). Dept. of Animal Ecology.
Rolf Henriksson.
Oikos, Vol 20, No 2, p 507-523, 1969. 22 fig, 1 tab, 23 ref.

Descriptors: *Water pollution, *Sound, Sediments, Water chemistry, Oxygen, Indicators, Hydrogen sulfide, Bacteria, Hydrogen ion concentration, Temperature, Salinity, Sewage effluents, Ice, Seasonal, Ammonia, Nitrites, Nitrates, Phosphorus, Invertebrates, Chemical analysis, Domestic wastes, Industrial wastes, Drainage water, Rain, Anaerobic conditions, Eggs, Habitats, Foods, Population, Clostridium.
Identifiers: *Bottom fauna, *Oresund (Sweden), Copenhagen (Denmark), Nereis diversicolor, Scoloplos armiger, Capitella capitata, Ampharete grubei, Terebellides stromi, Macoma balthica, Cardium lamarcki, Mya arenaria, Halicryptus spinulosus, Clostridium perfringers, Escherichia coli, Spio fuliginosa, Tubifex, Azoic area.

Pollution distribution estimates in the Sound (Oresund) between southern Sweden and Sjaelland, have been made based on frequency of indicator organisms. The relationship between sediment, water chemistry, and bottom fauna were investigated as well as the resistance of indicator species to low oxygen contents and hydrogen sulphide and their correlation to bacterial pollution. A narrow azoic zone close to the Sjolunda outlet and a similar zone on the Danish side outside Provesteen are heavily polluted as are the inner part of the Lomma Bay and a large area outside Copenhagen. Almost all the rest of the research area on the Danish side and the outer parts of the Lomma Bay are influenced by pollution with the exception of a small peripheral part of the study area outside Copenhagen. No pollutional influences were noted in small areas on the Swedish side and south of the Isle of Ven. A bottom community of Nereis diversicolor Muller, Scoloplos armiger Muller, Capitella capitata (F), Ampharete grubei Malmgren, Terebellides stromi Sars, Macoma balthica (L), Cardium lamarcki Reeve, Mya arenaria L, and Halicryptus spinulosus v Siebold proved useful in indicating pollution. (Jones-Wisconsin)
W70-04499

FISH AS INDICES OF EUTROPHICATION,
British Columbia Univ., Vancouver.
P. A. Larkin, and T. G. Northcote.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. p 256-273. 1 fig, 88 ref.

Descriptors: *Fish, *Eutrophication, Nutrients, Population, Growth rates, Foods, Pollutants, Distribution, Mortality, Reproduction, Ponds, Spatial distribution.
Identifiers: Fish food habits, Eutrophication indices, Fish culture, Ecological effects, Fish populations, Benefits of eutrophication.

Deliberate eutrophication has long existed as a practice in fish culture. Fish are the last, and perhaps least, affected by eutrophication; their variability in spatial distribution, growth, food habits, and survival make assessment of eutrophication effects difficult. This is offset somewhat by available statistics on population dynamics, by availability of physiological data, and by public interest. Nutrient-rich pollutants and their high oxygen demand affect fish directly, often lethally, at all life stages. High concentrations of decay-produced carbon dioxide adversely influence respiration; sedimentation and fungal growths adversely affect food organisms and spawning substrates. Sublethal effects may be more serious factors in population survival; these include sensory impairment, tissue degeneration, organ malfunction, changes in endocrine balance, and alterations in competitive success. Early stages of eutrophication may enhance growth, later stages may force changes in food habits and spatial distribution. Eutrophication has induced changes in yield and species composition of fish populations. The degree of advantage gained from eutrophication depends on better knowledge of processes involved in eutrophication and diversion of now-wasted nutrients into controlled culture processes. (See Vol. 3, No. 10, Field 5C, W70-03975). (Voigtlander-Wisconsin)
W70-04501

SOME ASPECTS OF FEEDING IN ZOOPLANKTON,
Michigan Univ., Ann Arbor.
George W. Saunders, Jr.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington D C, 1969, p 556-573. 2 fig, 5 tab, 33 ref.

Descriptors: *Feeding rates, *Zooplankton, Physiological ecology, Nutrition, Aquatic bacteria, Detritus, Organic matter, Kinetics, Radioisotopes, Daphnia, Food webs, Copepods, Environmental effects, Carbon radioisotopes, Michigan, Temperature, Phytoplankton, Biomass, Water pollution effects, Eutrophication.
Identifiers: *Trophic ecology, Cyclops bicuspidatus, Filtering rates, Frains Lake (Mich), Carbon-14, Ceriodaphnia, Bosmina, Nauplius, Tropocyclops, Keratella, Conochiloides, Codonella, Douglas Lake (Mich), Lancaster Lake (Mich), Nigger Creek (Mich), Assimilation.

A general system of zooplankton feeding is presented. The food system may be viewed as a buffered system. In lakes with little organic detritus, zooplankton depend primarily on phytoplankton. Detritus and bacteria provide an important food supply only during terminal phases of major phytoplankton blooms--providing a lightly-buffered system. Where organic detritus is at high concentrations, detritus may occupy a dominant role, together with phytoplankton, in zooplankton feeding. This system is highly buffered as sharp changes in concentrations of one food source are compensated. Bacteria generally have their major role in mineralization processes rather than as a food source, although certain conditions (decay of algal blooms) transpose them to an important food. Information on zooplankton feeding is confusing; discrepancies may be due to studying portions of systems or analyzing different systems. It is possible to determine filtering rates and analyze zooplankton feeding systems in nature; which may be easier than synthesizing such systems in the laboratory. Tabular data include estimates of total carbon assimilation by zooplankton under natural conditions. (See Vol. 3, No. 10, Field 5C, W70-03975). (Voigtlander-Wisconsin)
W70-04502

ALGAL NUTRITION AND EUTROPHICATION,
Haskins Labs., New York.
Luigi Provasoli.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969, p 574-593. 2 fig, 3 tab, 72 ref.

Descriptors: *Eutrophication, *Algae, *Nutrients, Nitrogen, Phosphorus, Sodium, Potassium, Trace metals, Vitamins, Water pollution, Physiological ecology, Diatoms, Oligotrophy, Cyanophyta, Chlorophyta, Great Lakes, Bioindicators, Fish, Washington, Lakes, Indiana, Ochromonas, Phytoplankton, Seaweeds.
Identifiers: *Algal nutrition, Ditylum, Chaetoceros, Skeletonema, Thalassiosira, Coccolithus, Sargasso Sea, Synura, Gymnodinium, Chemical symbiosis, Microbial ecology, Dinobryon, Volvox, Pandorina, Spirogyra, Synechococcus, Chroococcus, Oscillatoria, Nostoc, Anabaena, Anacystis, Microcystis, Bosmina, Asterionella, Melosira, Synedra, Fragilaria, Ceratium, Sweden, Aphanizomenon, Rhodomonas, Cryptomonads, Chrysomonads, Euglenids, Dinoflagellates.

Prevalent emphasis on nitrogen and phosphorus notwithstanding, little doubt exists that other nutrients play roles in eutrophication of natural waters. Also, accent is on aspects of biological overproduction in eutrophication, whereas more visible manifestations are changes in community structure, producing less desirable species via alterations in food chains. From these viewpoints, unfortunately little is known regarding ecologically important species. Selected nutritional aspects of algae are reviewed as regards nitrogen, phosphorus, sodium, potassium, trace metals, vitamins, and chemical symbiosis. In some situations, growth of chlorophytes (green algae) are favored by high concentrations of nitrogen, phosphorus, and potassium. Where chlorophytes are replaced, nitrogen-fixing blue-green algae may take over because nitrogen is too scarce to meet requirements of chlorophytes. It is known that both sodium and potassium increase during eutrophication. Such changes may be functional as well as indicative of eutrophication. Although trace elements are of acknowledged significance in algal nutrition, few reliable ecological data are available, and additional research is required. Vitamins are likely to be rich in eutrophic environments, a matter of importance since 197 of 204 algal species studied require vitamins, and since a pattern of vitamin requirements is beginning to emerge for various taxonomic groups. (See Vol. 3, No. 10, Field 5C, W70-03975). (Eichhorn-Wisconsin)
W70-04503

AGRICULTURAL DRAINAGE AND EUTROPHICATION,
Wisconsin Univ., Madison.
J. W. Biggar, and R. B. Corey.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, d c, 1969. p 404-445, 8 fig, 14 tab, 69 ref.

Descriptors: *Agricultural watershed, *Subsurface drainage, *Drainage, *Eutrophication, Nitrogen, Phosphorus, Surface waters, Percolation, Suspended load, Groundwater, Aquifer characteristics.
Identifiers: *Agricultural drainage, Dissolved nutrients, Water mixing, Russian River (Calif), Yakima Basin (Pacific Northwest), Lake Mendota (Wis).

A comprehensive review of numerous aspects involved in the relationship of agricultural drainage and water eutrophication is presented. Particular attention is given to chemical reactions that nitrogen and phosphorus undergo in soil-water system. The fate of nutrients transported by surface runoff, interflow, and deep percolating water is determined by complex coinfluencing factors, such as nature of suspended material, heterogeny of soil profile, and degree of water mixing. Stress is placed on the inapplicability of macro-parameters, such as average hydraulic conductivity, to processes occurring on a microscopic scale. The report includes illustrations of plant nutrient loss from harvested areas and contributions of fertilizing elements from agricultural lands. An appraisal of agricultural drainage influence on eutrophication requires investigations of chemical and mineralogical contents of runoff waters in different seasons, dynamics of groundwater, and water in the unsaturated zone below root systems. (See Vol. 3, No. 10, Field 5C, W70-03975). (Wilde-Wisconsin)
W70-04504

NUTRIENT OUTPUT FROM MANAGED FORESTS,
Michigan Univ., Ann Arbor.
Charles F. Cooper.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, DC, p 446-463, 1969. 3 tab, 39 ref.

Descriptors: *Riparian land, *Forests, *Forest fires, *Forest soils, Eutrophication, Ecosystems,

Nutrients, Runoff, Seepage, Subsurface flow, Stream gages, Lysimeters, Environmental sanitation, Fertilization, Statistical models, Estimating, Stochastic processes, Clear-cutting.
Identifiers: Forest hydrochemistry, Watershed input-output, Forest fertilization, Thin-film water dynamics.

Under undisturbed conditions, well stocked forest stands make very small contribution to eutrophication of natural waters, retaining nearly all input of phosphorus and nitrogen. However, a reduction in the density of stands and especially clear cuts, promotes the release of soluble nutrients and their discharge by an increased surface runoff and subsurface flow. Fertilization of forest stands may undesirably increase eutrophication of lakes and streams, especially when aerial broadcast includes water basins and riparian zones. Fish kills and other detrimental effects of eutrophication were recorded as consequences of forest fires followed by torrential rains. A great threat to forest lakes is presented by human wastes contributed directly by the vacationists and by seepage of septic tanks. (See Vol. 3, No. 10, Field 5C, W70-03975). (Wilde-Wisconsin)
W70-04505

ALGAE AND METROPOLITAN WASTES.
Public Health Service, Cincinnati, Ohio. Div. of Water Supply and Pollution Control; and Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

Transactions of seminar on Algae and Metropolitan Wastes held at Cincinnati, Ohio, April 27-29, 1960, sponsored by Div of Water Supply and Pollution Control and the Robert A Taft Sanitary Engineering Center. Bartsch, Alfred F, Chairman. Robert A Taft Sanitary Engineering Center, SEC TR W61-3, 1961. 162 p.

Descriptors: *Conferences, *Eutrophication, *Algae, Planning, Rivers, Lakes, Limnology, Wisconsin, Urbanization, Connecticut, Oregon, Washington, Primary productivity, Ecosystems, Illinois, Phosphorus, Drainage, Agricultural watersheds, Nitrogen fixation, Cyanophyta, Sewage effluents, Minnesota, Water pollution effects, Algicides, Water quality.
Identifiers: *Urban wastes, Madison (Wis), Lake Zoar (Conn), Klamath Lake (Ore), Lake Washington (Wash), Algal nutrition, Algal physiology, Heterotrophy, Micronutrients, Badfish River (Wis), Detroit Lakes (Minn), Nutrient removal, Mass communication.

In April 1960, a seminar met in Cincinnati, Ohio, to consider the problem, Algae and Metropolitan Wastes. The meeting, of which this volume constitutes the recorded transactions, was sponsored by Division of Water Supply and Pollution Control and Robert A Taft Sanitary Engineering Center, both agencies of the US Public Health Service. Discussions at the seminar were limited to prevention and control of objectionable algal blooms arising from enrichment of the hydrosphere by urban and other wastes. The conference was organized into panel discussions as follows: Statement of the Problem, Growth Characteristics of Algae, Sources of Nutrients, Methods of Prevention or Control. Topical coverage of sections, with number of contributions to each recorded in parentheses, will indicate scope and coverage of meeting: introduction (1); specific problems in lakes (4), and in rivers (1); algal nutrition (3); measurement of productivity (2); land drainage (2); wastes (1); limnological relationships (3); nutrient limitation (6); algicide use (1). The volume includes a summation of research needs and text of a banquet address by a journalist on theme of communication between scientist and layman. (See also W70-04507). (Eichhorn-Wisconsin)
W70-04506

BIOLOGICAL PROBLEMS IN WATER POLLUTION.

Tarzwell, Clarence M (editor). Third seminar, 1962. Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio, Public Health Service Publication No 999-WP-25, 1965. 424 p.

Descriptors: *Conferences, *Water pollution, *Aquatic environments, Shrimp, Crabs, Tubificids, Water quality, Bioindicators, Bioassays, Environmental effects, Ohio, Phytoplankton, Eutrophication, Aquatic insects, Invertebrates, Fish, Wildlife, Radioisotopes, Food chains, Toxicity, Organic pesticides, Fish diseases, Fish parasites, Fishkill, Diatoms, Cyanophyta, Aquatic bacteria, Protozoa, Crustaceans, Mollusks, Lakes, Rivers, Copper, Cesium, Dissolved oxygen, Effluents, Columbia River, Land use, Agricultural wastes.
Identifiers: *Water quality criteria, Italy, Marine environments, Freshwater environments, Cincinnati (Ohio), US Public Health Service, Microbial ecology, Zinc, Thermal effects.

This volume records proceedings of Third Seminar on Biological Problems in Water Pollution. Held in August 1962 at Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio, it was sponsored by Research Branch, Division of Water Supply and Pollution Control, US Public Health Service. Seminar's theme was water quality criteria for aquatic life. Organized into sections, with numbers of individual contributions to each recorded in parentheses, sectional topics reflect report's scope: value and use of water quality criteria (5); environmental requirements and effects on water quality of planktonic algae (4); environmental requirements of freshwater invertebrates (4), marine invertebrates (4), aquatic insects (5), fishes and wildlife (8); concentration by aquatic organisms of radionuclides, their passage through food chains and potential effects (4); bioindicators of pollution (3); detection, measurement, toxicity of organic pesticides (5); relationships of land use to hydrosphere (3); control of fish diseases and parasites (2); causes of fishkills (2); artificial eutrophication of hydrosphere (2); safe levels of pollutants and toxicants in hydrosphere (12). Publication includes summary, and text of address--Role of the Aquatic Biologist in the Federal Water Pollution Control Program, by James M Quigley, then Assistant Secretary of US Department of Health, Education, and Welfare. (See also W70-04509 and W70-04510). (Eichhorn-Wisconsin)
W70-04508

THE EUTROPHICATION OF LAKES AND RIVERS, CAUSE AND PREVENTION,
Zurich Univ. (Switzerland). Cantonal Lab.
Eugene A. Thomas.
Third seminar, 1962. Biological Problems in Water Pollution, Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio, Public Health Service Publication No 999-WP-25, p 299-305, 1965. 24 ref.

Descriptors: *Lakes, *Rivers, *Sewage effluent, Water quality control, Nitrogen, Phosphorus, Lake morphology, Color, Turbidity, Dissolved oxygen, Biological treatment, Aquatic plants, Aesthetics, Fishing harvest, Aeration, Cyanophyta.
Identifiers: *Artificial eutrophication, *Phosphorus removal, Sources of pollution, Mechanical treatment, Coregonen, Cladophora, Spirogyra, Ulothrix, Reeds, Oscillatoria limosa, Hydrodictyon reticulatum, Lake Zurich (Switzerland), Circular drainage systems, Plant removal, Chemical treatment, Pumping hypolimnion.

The consequences of sewage added to lakes and rivers is discussed together with the necessary conditions for permanent improvement of waters. Over-enrichment of lakes and rivers occurs by means of sewage effluents even after mechanical and biological purification. Thorough removal of phosphates from sewage as a direct measure against eutrophication is proposed. Other deterrents of eutrophication are prevention of sewage discharge to lakes through circular drainage systems, intensive development of fishing, plant removal, chemical treatment of waters, aeration of deep waters, drawing off deep waters in lakes, and introducing fresh water to deoxygenated waters. (See W70-04508). (Ketelle-Wisconsin)
W70-04509

ALGAE AS INDICATORS OF POLLUTION,
Academy of Natural Sciences of Philadelphia, Pa. Dept. of Limnology.
Ruth Patrick.
Third seminar, 1962. Biological Problems in Water Pollution, Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio, Public Health Service Publication No 999-WP-25, p 225-231, 1965. 4 fig, 1 tab, 33 ref.

Descriptors: *Algae, *Bioindicators, *Water pollution, Diatoms, Maryland, Pennsylvania, Rivers, Streams, Euglena, Aquatic populations, Eutrophication, Cyanophyta, Sewage effluents, Chlorophyta, Rhodophyta, Physiological ecology, Industrial wastes, Hydrogen ion concentration, Iron compounds, Hydrogen sulfide, Lead, Copper, Ammonia, Conductivity, Chromium, Phenols, Nitrogen, Calcium, Dissolved oxygen.
Identifiers: Community structure, Ridley Creek (Pa), Nobs Creek (Md), Back River (Md), Oscillatoria, Catherwood diatometer, Savannah River, Population dynamics, Algal communities, Microbial ecology, Water quality criteria, Cyanide, Naphthenic acid.

Extensive literature has developed regarding algal indicators of pollution. Pollution concept refers to various physical and chemical changes in the hydrosphere produced by human activities. Earliest recognizable form of pollution resulted from organic contamination, and species were classified according to degrees of organic pollution they tolerated. Little attention was focused on population dynamics of various species or on holistic aspects of algal communities. Because of increasing diversity and complexity of pollutional loads and because environment strongly affects their occurrence and population size, assessing pollution by presence or absence of a few species is inclined to be misleading. Thus, well established populations of several algal species may indicate presence of particular forms of pollution, but their elimination or decrease may result from causes very different than changes in pollutional load. Because algal communities integrate effects of influencing factors, more recent study of pollution has been directed to consider structure of the entire algal community as indicative of pollution. Examples are cited of several such approaches, considering various forms of pollution at a number of different localities. Discussion following the paper developed information that Euglena and Oscillatoria are often cited as genera most tolerant to sewage and related conditions. (See W70-04508). (Eichhorn-Wisconsin)
W70-04510

5D. Waste Treatment Processes

PROGRESS AND DEVELOPMENTS IN TREATMENT OF INTEGRATED TEXTILE MILL WASTES,
Colorado State Univ., Fort Collins. Natural Resources Center.
T. A. Alspaugh.
Proceedings 12th Southern Municipal Industrial Waste Conference, North Carolina State Univ, Raleigh, NC, p 46-62, 1964.

Descriptors: *Activated sludge, *Biochemical oxygen demand, *Color, Waste water treatment, Treatment facilities, Aeration, Lagoons, Domestic wastes, Sedimentation, Chlorination, Sludge, Detergents, Spraying, Algae, Centrifugation, Filtration, Anerobic digestion, Incineration, Iron compounds, Sulfates.
Identifiers: *Anti-foam agents, *Textile wastes, Fiber wastes, Dyeing wastes.

A full-scale plant was constructed to treat 21 mil. gal. per week by the 24-hour high-solids activated-sludge process in which the longer aeration period and the higher solids concentrate in the aeration tank both assist in removing the highly-soluble biochemical oxygen demand of textile waste waters, buffering shock loads, and providing efficient treatment as regards removal of color. The textile waste waters pass through two storage lagoons in series (to provide equalization and some removal of lint and dye paste) and are mixed with 10% of screened and degritted domestic sewage before entry into the aeration tank. After final sedimentation the effluent is chlorinated and reaerated before discharge to a creek. Operating data are tabulated showing an average biochemical oxygen demand removal of 89-90% and color removal of 50-75%. The problem of foaming is accentuated by the high concentrate of synthetic detergents in textile waste waters; the most successful treatment methods are spraying with crude waste water, alone or with the addition of anti-foaming agent on to the rotor blades, and possibly the removal and destruction of foam by a vacuum pump. The poorly-settling sludge was found to contain heavy growths of algae. The problem could be overcome by allowing the sludge to become septic before return to the aeration tank, or by introducing a shock load of organic algae. However, these algae have good characteristics for removal of biochemical oxygen demand and color. Excess sludge from the treatment of textile waste waters is difficult to settle and concentrate. Rates of vacuum filtration and centrifugation are low compared with sewage sludge. At present the sludge is discharged to the municipal sewer. Other promising methods of disposal appear to be vacuum filtration and centrifugation. (Livengood-North Carolina State Univ)
W70-04060

NUTRIENT REMOVAL FROM CANNERY WASTES BY SPRAY IRRIGATION OF GRASSLAND,
Robert S. Kerr Water Research Center, Ada, Okla.
James P. Law, Jr., R. E. Thomas, and Leon H. Myers.
Available from the Clearinghouse as PB-189 774, $3.00 in paper copy, $0.65 in microfiche. FWPCA Water Pollution Control Research Series 16080...11/69, Nov 1969. 73 p, 23 tab, 8 fig, 18 ref, 3 append.

Descriptors: *Wastewater treatment, *Soil disposal fields, *Canneries, Industrial wastes, Pollution abatement, Hydrologic aspects, Water conservation.
Identifiers: *Grassland irrigation, *Soil treatment system, Spray-runoff, Cannery waste water, Nutrient removal.

The Campbell Soup Company plant at Paris, Texas, treats wastewater from the processing operations by spraying onto grassland. Vegetable solids and grease residues are separated and recovered. A comprehensive 12-month study was conducted to determine treatment efficiencies of the spray-runoff treatment system. A total of 133 inches of wastewater was applied to four experimental areas during the study period. Hydrological measurements, chemical removal efficiencies, and changes in soil properties were evaluated in relation to years of wastewater application, soil type, and spray schedule. Hydrological measurements accounted for 93 percent of the total liquid applied and showed that evaporative losses accounted for 18 percent of the total liquid applied; runoff accounted for 61 percent. During periods of heavy rainfall, runoff increased to a maximum of 80 percent of the total applied liquid. The results showed that the system achieved mass removals of 92 to 99 percent of the volatile solids and oxygen-demanding substances, 86 to 93 percent of total nitrogen, and 50 to 65 percent of phosphorus. Soil textural class and system age had very little effect on treatment efficiencies. Evaluation of surface and subsoil samples and soil water at the 3-foot depth indicated an increase in salinity with age, but nitrogen and phosphorus remained low. Much of the phosphorus removed from the wastewater was found in the surface soil layer.
W70-04062

DISSOLVED-AIR TREATMENT OF COMBINED SEWER OVERFLOWS, A DEMONSTRATION PROJECT OF A PROTOTYPE TREATMENT PLANT DESIGNED TO TREAT WASTES FOUND AT A COMBINED SEWER OVERFLOW.
Rhodes Technology Corp., Houston, Tex.

Available from the Clearinghouse as PB-189 775, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration, Research Series, WP20-17, Jan 1970. 216 p, 17 tab, 17 fig, 22 ref, 5 append. FWPCA Program 11020 FKI. Contract No 14-12-11.

Descriptors: *Combined sewers, Storm water, *Overflows, *Dissolved-air flotation, Infiltration, Treatment methods, Primary treatment, Flocculant aide, Suspended solids, Storm runoff.

A dissolved-air flotation system was evaluated for primary treatment of combined sewer overflows. The major pieces of component equipment were a gyratory screen, hydrocyclones, an air dissolving tank, and a flotation cell. The principal aspects investigated were: (1) Performance of the system during rain events and dry periods; (2) Evaluation of individual components; (3) Capital costs and operating costs for utilizing a flotation system for various size combined sewage overflows; (4) The adaptability of the system for automation and use in remote location; and (5) The ability of the system to treat intermittent and highly variable flows from combined sewage systems. Some chemical aids to flocculation were also tested. The system performed comparably to conventional clarifiers. It appears dissolved-air flotation systems would be economical for handling combined sewer overflows up to 8 MGD. Automation of dissolved-air flotation systems appears possible with conventional control equipment. Chemical aids to flocculation appear to have promise that warrants further study. The system was unique in that all liquid flow passed directly through the air dissolving tank with no recycle. Domestic sewage was studied in lieu of combined sewage during periods of no rain. Conclusions, recommendations, and benefit-cost relationships are presented in the report. A description of the demonstration plant and of the drainage area served by the flotation system are appended.
W70-04063

SEWERAGE AND SEWAGE DISPOSAL IN COLD REGIONS,
Army Terrestrial Sciences Center, Hanover, N.H.
Amos J. Alter.
Available from the Clearinghouse as AD-698 452, $3.00 in paper copy, $0.65 in microfiche. Cold Regions Services Engineering Monograph III-C5b, Oct 1969. 110 p. DA Project 1T062112A130.

Descriptors: Frost protection, Lagoons (Ponds), Sewage, *Sewage disposal, *Sewage treatment, Sewers, Utilities (Cold regions), *Waste disposal.

The main items dealt with in this monograph of 106 pages are: Practice and problems, Collection and transport, Treatment and processes, Thermology, Re-use and regenerative processes, and Construction and operation. There are 225 references, 54 illustrations, and 18 tables. Six appendixes treat stabilization ponds, ventilation of buildings having sewage treatment plant, solid wastes, and other topics.
W70-04064

BIOLOGICAL TREATMENT OF HIGHLY-ALKALINE TEXTILE MILL WASTE-SEWAGE MIXTURE.
Proceedings American Society Civil Engineers, Vol 81, No 750, p 750-1--750-4, 1955.

Descriptors: *Biological treatment, *Waste water (Pollution), *Sewage, Alkalinity, Sedimentation, Biochemical Oxygen Demand, Color, Hydrogen Ion Concentration.
Identifiers: *Textile wastes, Percolating filters.

Pilot-plant studies were made on the biological treatment of a mixture of textile manufacture waste waters and sewage on percolating filters, without previous neutralization of the high alkalinity. The waste waters, with a pH value of 10.5, were mixed with sewage in the proportion of 4 percent waste water to 96 percent sewage, the amount of waste water gradually increased to 40 percent, and the mixture applied to the experimental filter at a BOD loading of 2.73 lbs/sq.yd. Examination of the filter effluent showed a reduction in BOD of 51 percent, and in color of 42.5 percent; the pH value was 9.1. A total reduction in BOD of 58 percent was obtained after final sedimentation. (Livengood-North Carolina State Univ)
W70-04084

DEVELOPMENT OF WATER PURIFICATION SYSTEMS BASED ON REVERSE OSMOSIS,
Pratt and Whitney Aircraft, East Hartford, Conn.
For primary bibliographic entry see Field 03A.
W70-04086

BIOLOGICAL TREATMENT OF INDUSTRIAL EFFLUENTS,
N. Blakebrough.
International Dyer, Textile Printer, Bleacher, and Finisher, Vol 135, p 909-911, 1966.

Descriptors: *Biological treatment, *Domestic wastes, *Biochemical oxygen demand, *Treatment facilities, Industrial wastes, Economics, Flow rates, Aeration, Trickling filters, Microorganisms, Organic matter.
Identifiers: Lubeck process.

The Lubeck Process for the biological treatment of wastes sprays effluent tangentially above the surface of a circular aeration tank. (Spraying aerates waste faster and supresses the tendency to foam). The offtake in the center bottom of the tank gives a spiral flow. Air jets and tank construction provide a rolling circulation transverse to the direction of bulk flow; together these flows keep the floc well mixed and suspended. From the aeration tank the effluent goes to a settling tank. The process handles shock loads by diluting through the system and by speeding up the cycling of sludge and liquors. Removal of biochemical oxygen demand is between 88 and 98%. For a given duty, the aeration tank volume for the Lubeck process may be 1/4 to 1/10 that of a conventional plant. Total power requirements for the process are usually between 0.2 - 0.3 kw-hr. per pound of biochemical oxygen demand. (Sheffield - North Carolina State Univ)
W70-04087

METHODOLOGY OF THE ORIENTATION TEST FOR THE AMENABILITY OF WASTE WATERS TO PURIFICATION BY THE ACTIVATED-SLUDGE PROCESS (Czechoslovakian),
A. Borovickova, and V. Zahradka.
Sbornik Vysoke Skoly Chemicko-technologicke v Praze, Vol 8, No 1, p 393-416, 1964.

Descriptors: *Activated sludge, *Biochemical oxygen demand, Industrial wastes, Aerobic bacteria, Microorganisms, Sewage, Copper, Chromium, Phenol, Cotton.
Identifiers: *Dyeing wastes, Warbur-respirometer, Toxicity, Cyanides.

After a comparative review of methods for assessing the effect of trade waste waters (or their toxic constituents) on the aerobic micro-organisms involved in the treatment of municipal sewage by the activated sludge process, the authors describe and explain a direct manometric method developed at the Hydraulic Research Institute, Prague, and based on determination of the oxygen demand in the given substrate using an apparatus of the Warburg-respirometer type. The method and formulae used for calculating the results are explained and experiments showing the effect of copper and hexavalent chromium on the BOD curve for synthetic

municipal sewage and the effects of syanide on the curve for phenolic waste waters. Further studies were also made with cotton-dyeing waste waters and with a mixture of municipal sewage and spent sulphite liquor. In all cases results were confirmed by tests in a laboratory-scale activated-sludge plant. It was concluded that the manometric method gives reproducible biochemical results and indicates objectively the toxicity of the test material towards the aerobic microorganisms. (Livengood-North Carolina State Univ)
W70-04148

FINISHING CHEMICALS FOR KNIT GOODS: SHOULD THEY REALLY BE BIODEGRADABLE,
Fancourt (W. F.) Co., Greensboro, N.C.
R. H. Beaumont.
American Dyestuff Reporter, Vol 54, p P667-P668, 1965.

Descriptors: *Biodegredation, *Biological Oxygen Demand, *Surfactant, Standards, Soaps, Foaming, Bacteria, Detergents.
Identifiers: *Finishing wastes, Knitted fabrics, Textile chemicals.

When an industry empties effluent directly into a stream the replacement of branched-chain detergents with new straight-chain detergents will not produce a low bacterial oxygen demand or reduce the foam problem in the immediate vicinity of the plant. The surfactant that this industry needs is one that decomposes quickly but only to the extent of losing its foam-producing power. If the effluent passes through a treatment system, biodegradables are desirable. The new biodegradable detergents will not behave identically to the non-biodegradable ones in many industrial processes, and adjustments are sometimes necessary. The price of biodegradables is about equal to that of non-biodegradable materials. (Sheffield-North Carolina State University)
W70-04167

COLOR REMOVAL FROM AZO DYE WORKS.

Journal of Sanitary Engineering Division, Proceedings American Society Civil Engineers, Vol 84, No SA2, Paper No 1611, p 1611-1--1611-4, 1958.

Descriptors: *Waste water treatment, Color.
Identifiers: *Dyeing wastes, *Azoic dyes, Chlorine compounds, Tin compounds.

In this report of the Sanitary Engineering Research Committee, Industrial Wastes Section of the American Society of Civil Engineers, the results are given of experiments on the treatment of ten typical azo dyes which are frequently used in the textile industry, with stannous chloride. The color of the dyes was completely destroyed by heating at 212 deg F for 2 hours in the presence of a small amount of stannous chloride. (Livengood-North Carolina State Univ)
W70-04197

DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS.

Am Water Wks Ass'n J, Vol 61, No 11, p 619-638, Nov 1969. 20 p.

Descriptors: *Waste water treatment, *Water treatment, *Waste disposal, *Waste water disposal, Brine disposal, Ultimate disposal, Environmental engineering, Sanitary engineering, Sludge disposal, Lagoons, Water Quality Act, Waste water (Pollution), Sludge treatment, Reclaimed water, Water reuse, Water pollution treatment, Environmental sanitation, Filtration, Oxidation lagoons, Coagulation, Industrial wastes, Municipal wastes, Water softening, Treatment facilities, Water quality control.
Identifiers: *Filter washwater.

A status report on water treatment plant operation is presented. Because of recent federal action and stricter state regulations applying to the discharge of water treatment plant wastes into surface streams, the disposal of such wastes poses a problem of plant operation. Alum coagulant sludge is the prime type of waste produced by water treatment plants. Plant operations for disposal of alum and other coagulant wastes include direct discharge to surface waters, lagooning, discharge to sanitary sewers, freezing, centrifuging, vacuum filtration, sand bed and wedge wire drying, filter pressing, barging to sea, pipeline transportation, and alum recovery. The advantages and disadvantages of each method of disposal are discussed. Filter washwater can be disposed of by treatment and recovery. Methods for disposal of softening plant sludges are generally similar to those used for the disposal of alum sludges. No significant advancements have been made in methods for disposal of the spent brines from cation-exchange softening operations. Ten techniques needed to solve the problem of waste disposal from water treatment plants are suggested. A status report on regulatory aspects of plant waste disposal and a summary of the survey of state regulatory agencies by the American Water Works Association Research Foundation are presented. (Powell-Florida)
W70-04212

WATER, WASTE WATER, AND HEAT IN INDUSTRY (IN GERMAN).

Ciba Ltd., Basle, Switzerland. 71 p, 1961.

Descriptors: *Water supply, *Standards, Waste water treatment, Water treatment.
Identifiers: *Chemical composition, Textile wastes.

A report is given of papers and discussions at a CIBA conference held in Zurich in June, 1961. Subjects dealt with included the collection, composition and treatment of different types of water supply with special reference to the requirements of the textile industry, and the composition and methods of treatment of waste waters from the various processes of the textile industry. The report is illustrated with photographs, plans and diagrams of water supply plant and treatment plant for water waste. (Livengood-North Carolina State Univ)
W70-04218

THE BIOCHEMICAL OXYGEN DEMAND OF TEXTILE CHEMICALS: UPDATED LIST 1966.

American Dyestuff Reporter, Vol 55, No. 18, p 685-688, 1966. 9 ref.

Descriptors: *Biochemical Oxygen Demand, Bio Degredation, Test Procedures.
Identifiers: *Textile Chemicals, Chemical Composition.

Textile chemicals are listed and five-day BOD is given, as determined by the Winkler (Azide Modification) Method found in the 'Standard Methods for the Examination of Water, Sewage, and Industrial Wastes' published by the American Public Health Association. The values are given as percents based on the weight of the chemical as received. The composition and use of each chemical is given. The BOD test is used as an index of pollution and is a good method for the measurement of complete biological decomposition into such compounds as carbon dioxide and water. (Sheffield-North Carolina State Univ)
W70-04240

BIOLOGICAL MEASUREMENT OF WATER POLLUTION,
Beak (T. W.) Consultants Ltd., Collins Bay (Ontario).
T. W. Beak.
Chemical Engineering Progress, Vol 60, No 1, p 39-43, 1964. 5 fig, 10 ref.

Descriptors: *Waste water (Pollution), Water analysis, Measurements, Biology, Microorganisms, Biological properties.

Basic to the biological measurement of pollution is the normal aquatic community with sensitive and tolerant plants and animals in equilibrium. When pollution enters the environment, a degree of change in species composition occurs proportional to the degree of environmental change; the most sensitive species are eliminated first, with tolerant species remaining. The non-numerical nature of biological data has hindered its use in measuring pollution. Two methods are given for putting biological data into a quantitative form. The Biological Score Method establishes normal distribution on control waters and assigns a maximum number of points. Polluted streams are then judged and given a lower number of points in proportion to the amount of pollution present. Scores can be equated to various uses, and differences between two sides of a river or up and down stream can be shown on one chart. The Bivariate Chart Method depends on statistical analysis of biological data on aquatic animal communities to make control charts for detecting significant change in the community and monitoring pollution. (Sheffield-North Carolina State Univ)
W70-04241

TREATMENT OF MIXTURES OF TEXTILE WASTE AND DOMESTIC SEWAGE,
Cone Mills Corp., Greensboro, N. C.
R. H. Souther, and T. A. Alspaugh.
American Dyestuff Reporter, Vol 47, No 14, p 480-488, 490, 1958. 1 fig, 18 ref, 18 tab.

Descriptors: *Domestic wastes, *Biochemical oxygen demand, Water pollution control, Waste disposal, Cotton, Coagulation, Biological treatment, Hydrogen-ion concentration, Trickling filters, Standards, Toxicity, Waste water treatment.
Identifiers: *Souring waste, *Slashing wastes, *Desizing wastes, *Bleaching wastes, Finishing wastes, Mercerizing wastes, Starch, Wool, Sodium carboxymethylcellulose, Sodium hydroxide.

The treatment of textile waste has long been considered a difficult problem due to variability, strength, and alkaline nature of the waste. Many consultants in the past have stated that combined treatment with sewage was not feasible without expensive chemical pretreatment, and therefore, separate treatment recommendations have prevailed. This paper is a discussion of research at Cone Mills to evaluate combined treatment against separate treatment with and without pretreatment. The methods investigated include physical, chemical, and biological processes, particularly the effect of lagooning as an aid to waste treatment. Conclusions indicate that biological treatment of combined textile waste and domestic sewage without chemical pretreatment is practical and economical. Lagooning can be expected to reduce both initial cost and operating expenses. (Sheffield-North Carolina State Univ)
W70-04243

TREATMENT OF INDUSTRIAL WASTES IN THE UNITED STATES,
Purdue Univ., Lafayette, Ind.
Don E. Bloodgood.
Institute of Sewage Purification Journal and Proceedings, Pt 4, p 359-370, 1958. 14 ref.

Descriptors: *Legislation, *Standards, *Radioactive wastes, *Incineration, Phenol industrial wastes, Lagoons.
Identifiers: Waste water treatment, Recovery (Wastes).

The methods of government control in handling of industrial wastes are listed for the federal government, groups of states that have agreed upon compacts, state governments, sanitary districts or other subdivisions of local communities, and municipal governments. 'Model ordinance' specifications for

municipalities are given. Some assisting agencies and symposia are named. Finally, the following waste problems and disposal methods are discussed: (1) underground disposal, (2) refinery wastes, (3) spray and ridge and furrow irrigation of wastes, (4) phenol recovery, (5) incineration of solid cyanide wastes, (6) metal-plating wastes disposal, (7) low stream flow augmentation, (8) industrial re-use of water, (9) circulating lagoons, (10) methods of dealing with radioactive wastes, and (11) a proposed method for recovery of solids from solutions, especially waste liquors and sludges. (Sheffield-North Carolina State Univ)
W70-04244

POLLUTION CONTROL OF NEW ENGLAND INTERSTATE WATERS,
Joseph C. Knox.
American Dyestuff Reporter, Vol 47, No 14, p 477-479, 491, 1958. 2 tab, 4 ref.

Descriptors: *Domestic wastes, *Biochemical Oxygen Demand, Water Pollution Control, Waste disposal, Cotton, Coagulation, Biological treatment, Hydrogen-ion concentration, Trickling filters, Standards, Toxicity, Waste water treatment.
Identifiers: *Scouring waste, *Slashing wastes, *Desizing wastes, *Bleaching wastes, Finishing wastes, Mercerizing wastes, Starch, Wool, Sodium carboxymethylcellulose, Sodium hydroxide.

The New England Interstate Water Pollution Control Commission administers a compact of seven states for the control of water pollution in the interstate inland and tidal waters of the area. The compact is based on a system of classification of waters according to proposed highest use, with physical, chemical and bacteriological standards established for each class. Commission research showed the textile industry to be the largest contributor of wastes. Textile pollution comes from two sources: natural impurities, highest in woolen mills, and process chemicals. In most plants chemicals account for 80% of BOD, but chemical substitution can often eliminate 50%-90% of this. The paper outlines the criteria used in classification of streams under commission control. (Sheffield-North Carolina State Univ)
W70-04247

COMBINED TREATMENT - BLEACHERY WASTE AND DOMESTIC SEWAGE,
Cannon Mills Co., Kannapolis, N.C.
John L. Brown, Jr.
American Dyestuff Reporter, Vol 47, No 14, p 489-490, 1958. 1 ref.

Descriptors: *Domestic wastes, *Biochemical Oxygen Demand, Water Pollution Control, Waste disposal, Cotton, Coagulation, Biological treatment, Hydrogen-ion concentration, Trickling filters, Standards, Toxicity, Waste water treatment.
Identifiers: *Scouring waste, *Slashing wastes, *Desizing wastes, *Bleaching wastes, Finishing wastes, Mercerizing wastes, Starch, Wool, Sodium carboxymethylcellulose, Sodium hydroxide.

Cannon Mills Company segregates waste into starches, caustic wastes, and general wastes. The first two contribute most to pollution and are treated; general wastes are by-passed. Treatment involves (1) segregation, (2) storing caustic wastes, (3) treating waste through a conventional two-stage, high-rate trickling filter plant, and (4) chlorination. The storage lagoon for caustic wastes enables pH control through the plant on a seven-day basis: converts 65% of the hydroxide alkalinity to carbonate or bicarbonate, and reduces BOD 15%. Starch wastes are settled separately, and lime is added to prevent fermentation. Domestic sewage and slasher waste enter the caustic wastes in primary settling tanks, where remaining alkalinity is removed. Four fans blow under the drain system of the filters, eliminating odor and increasing filter efficiency 30%. Chlorine is added at up to 3000 pounds per day, depending on stream condition. Sludge is removed from digestors weekly. The plant treats 60% textile waste and 40% domestic sewage; the operator can control flow rates, pH, and biological load. (Sheffield-North Carolina State Univ)
W70-04248

TREATMENT OF MUNICIPAL WASTES,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05C.
W70-04274

LABORATORY STUDIES ON THE REMOVAL OF PHOSPHATES FROM SEWAGE BY THE COAGULATION PROCESS,
Norsk Institutt for Vannforskning, Blindern.
Arne Henriksen.
Schweizerische Zeitschrift fur Hydrologie, Vol 24, p 253-271, 1962. 9 fig, 1 tab, 19 ref.

Descriptors: *Sewage, *Sewage treatment, Hydrogen ion concentration, Phosphates, Phosphorus compounds, Coagulation, Detergents.
Identifiers: Orthophosphates, Polyphosphates, Hydrolyzable phosphate, Aluminum sulfate, Ferric sulfate, Molar capacity, Langmuir adsorption isotherm.

Removal of phosphates from sewage by coagulation was accomplished in an apparatus similar to that designed by Packham. Samples of settled sewage of pH 7.8, containing 11.45 milligram/liter phosphate as orthophosphate and 5.75 milligram/liter phosphate as hydrolyzable phosphate, were coagulated with 50 and 200 ppm aluminum sulfate and 40 and 200 ppm ferric sulfate. After filtration the samples were analyzed for orthophosphates. Using aluminum sulfate, an effective removal of orthophosphates was obtained at the pH range 6.0-7.1; the corresponding range with ferric sulfate was 4.7-7.4. Trials with different concentrations of chemicals and addition of acetic acid indicated that ferric sulfate is a more efficient coagulant, especially applicable to hydrolyzable phosphates. A significant part of the latter is represented by polyphosphates from synthetic detergents. Under conditions of these trials, polyphosphates appear to be more vulnerable to removal than orthophosphates. (Wilde-Wisconsin)
W70-04289

REGENERATION OF SPENT GRANULAR ACTIVATED CARBON,
MSA Research Corp., Callery, Pa.
A. J. Juhola, and F. Teppar.
Available from the Clearinghouse as PB-189 955, $3.00 in paper copy, $0.65 in microfiche. Robert A. Taft Water Research Center Report No TWRC-7 Federal Water Pollution Control Administration, Feb 1969. 91 p, 18 fig, 28 tab, 5 ref, 2 append. FWPCA Project 11020...2/69. Contract No 14-12-107.

Descriptors: *Activated carbon, *Tertiary treatment, *Treatment facilities, Waste water treatment, Water purification, Research and development.
Identifiers: Activated carbon regeneration.

The regeneration of spent granular activated carbon, used in tertiary treatment of municipal waste water, is a three-step process, (1) drying, (2) baking and (3) activating. Laboratory studies with an indirect heated rotary tube furnace demonstrated that the rates at which the drying and baking steps are performed do not have a significant effect on the properties of the baked carbon. The controlling step for the regeneration product is the activation, and the important parameters are the carbon temperature, length of activating time, and steam or carbon dioxide concentration in the activating gas mixture. In multiple hearth furnace regenerations, where the reported carbon losses are 5% to 7% per regeneration, the characteristics of the activating step are: (1) high activating gas input rate, (2) relative short activating time, and (3) relatively low carbon temperature. Thermodynamic calculations made on the hearth furnace regeneration indicate that, by performing only the activation of a previously baked carbon, the hearth furnace gas input rate can be reduced drastically and to the point where it approaches the optimum rate of the rotary tube. (Knapp-USGS)
W70-04297

COST AND PERFORMANCE ESTIMATES FOR TERTIARY WASTEWATER TREATING PROCESSES,
Robert A. Taft Water Research Center, Cincinnati, Ohio.
Robert Smith, and Walter F. McMichael.
Available from the Clearinghouse as PB-189 953, $3.00 in paper copy, $0.65 in microfiche. Robert A. Taft Water Research Center Report No TWRC-9, Federal Water Pollution Control Administration, June 1969. 27 p, 7 fig, 6 tab, 5 ref. FWPCA Project 17090...6/69.

Descriptors: *Tertiary treatment, *Water costs, *Cost analysis, *Performance, Activated carbon, Oxidation, Filtration, Sewage treatment, Waste treatment, Water pollution control.
Identifiers: Lime clarification, Ammonia stripping, Microscreening.

Generalized estimates of both performance and cost are presented for wastewater treatment processes which can be used with activated sludge process to reduce the pollution load on the receiving stream. Processes and groups of processes believed to be leading candidates for use downstream of secondary treatment are listed. Data from various sources on the fraction of 5-day BOD associated with suspended solids are tabulated. Microscreening or rapid sand filtration removes about 42% of the 5-day BOD and 21% of the COD and TOC. Other solids-removing processes, such as lime clarification, multimedia filtration, and granular carbon adsorption, remove a greater fraction of the suspended solids. Some of the dissolved organic contaminants might be removed, but this appears to be negligible. A large fraction of the dissolved organic species is removed by granular carbon adsorption. Estimates of the concentrations of BOD, COD, TOC, nitrogen, and phosphorus downstream of each group of processes are tabulated. Estimated capital and operating and maintenance costs for each process are shown. (Knapp-USGS)
W70-04298

ARTIFICIAL-RECHARGE EXPERIMENTS UTILIZING RENOVATED SEWAGE-PLANT EFFLUENT - A FEASIBILITY STUDY AT BAY PARK, NEW YORK, U.S.A.,
Geological Survey, Mineola, N.Y.
Philip Cohen, and C. N. Durfor.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 193-199, 1967. 7 p, 4 fig, 3 ref.

Descriptors: *Artificial recharge, *Recharge wells, *Water reuse, *New York, *Saline water intrusion, On-site tests, Tertiary treatment, Filters, Groundwater movement, Injection wells, Observation wells, Costs.
Identifiers: Long Island (NY), Barrier injection wells.

The U.S. Geological Survey, in cooperation with the Nassau County Department of Public Works, is conducting a series of artificial-recharge experiments on Long Island, New York to obtain scientific and economic data needed to evaluate the feasibility of injecting highly treated sewage-plant effluent into a proposed network of 'barrier' injection wells that are intended to prevent or retard the landward movement of salty water from the Atlantic Ocean into major aquifers. Tertiary sewage treatment was developed to produce an effluent that meets requirements commonly accepted for potability. An experimental injection well and injection plant have been completed. Remote sensing downhole geochemical probes permit the measure-

ment of water-quality and hydraulic-head changes at several points within the injection well and the filterpack. (Knapp-USGS)
W70-04355

METHOD FOR THE REMOVAL OF SOLUBLE PHOSPHATES IN WASTE WATER TREATMENT,
Allied Chemical Corp., New York.
John C. Eck, and William C. Zegel.
US Patent 3,453,207, July 1, 1969, 5 p. 1 tab, 2 ref.

Descriptors: *Waste water treatment, *Phosphates, *Cation exchange, Emulsifiers, Patents.
Identifiers: *Alum, Soluble phosphates, Synthetic cationic organic latex, Polymerization, Olefins, Dienes, Halogen, Copolymerization.

This invention relates to precipitation of dissolved phosphate ion in water by a combination of alum and a cationic organic latex followed by separation of the substantially free water from the phosphate-containing precipitate. 'Synthetic cationic organic latex' contemplates a water based emulsion formed by a free radical emulsion polymerization of 2-carbon to 30-carbon olefins, 4-carbon to 30-carbon dienes and halogen, ester or aryl substituted olefins or dienes of the above chain length or mixtures thereof with each other in water and a cationic organic emulsifying agent. Only limitation imposed is that resultant polymer or copolymer must be water soluble. Preferable compounds for the preparation of the lattices along with several illustrative examples are described. Data from 17 runs indicates that treatment of wastewater by the simultaneous addition of 10 ppm of a variety of lattices and 40 ppm of alum is as effective at removing dissolved phosphate as treatment with 150 ppm of alum alone. Treatment of wastewater with cationic latex effects essentially no phosphate removal. Treatment with 40 or 50 ppm of alum alone is significantly less effective than treatment with the synergistic combination of 40 ppm of alum and 10 ppm of latex. (Haskins-Wisconsin)
W70-04463

THE EUTROPHICATION OF LAKES AND RIVERS, CAUSE AND PREVENTION,
Zurich Univ. (Switzerland). Cantonal Lab.
For primary bibliographic entry see Field 05C.
W70-04509

5E. Ultimate Disposal of Wastes

SEWERAGE AND SEWAGE DISPOSAL IN COLD REGIONS,
Army Terrestrial Sciences Center, Hanover, N.H.
For primary bibliographic entry see Field 05D.
W70-04064

DISPOSAL OF LIQUID WASTES BY INJECTION UNDERGROUND - NEITHER MYTH NOR MILLENNIUM,
Geological Survey, Carmel, Calif.
Arthur M. Piper.
Report available at no cost from US Geological Survey, Wash, DC 20242. Geological Survey Circular 631, 1969. 15 p, 2 tab, 94 ref.

Descriptors: *Waste disposal, *Injection wells, *Well regulations, Aquifers, Water quality, Earthquakes, Water storage, Water pollution sources, Water pollution control, Surveys, Legislation, Legal aspects, Economics, Regulation, Administrative agencies, Management.
Identifiers: Waste disposal wells.

Injecting liquid wastes deep underground is an attractive but not necessarily practical means for disposing of them. For decades, impressive volumes of unwanted oil-field brine have been injected, currently about 10,000 acre-feet yearly. Recently, liquid industrial wastes are being injected in ever-increasing quantity. Effects of deep injection are complex and not all are understood clearly. In a responsible society, injection cannot be allowed to put wastes out of mind. Injection is no more than storage--for all time in the case of the most intractable wastes--in underground space of which little is attainable in some areas and which is exhaustible in most areas. Standards by which to categorize the wastes are urgently desirable. To the end that injection may be planned and administered, there is proposed an immediate and comprehensive canvass of all the United States. Such a canvass would consider (1) natural zones of groundwater circulation, from rapid to stagnant, (2) regional hydrodynamics, (3) safe injection pressures, and (4) geochemical aspects. Only Missouri, Ohio, and Texas have statutes specifically to regulate injection of industrial wastes. Some new, fully competent institutional arrangement appears to be essential, under a unified policy. (Knapp-USGS)
W70-04103

DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS.
For primary bibliographic entry see Field 05D.
W70-04212

ANIMAL WASTE DISPOSAL PROBLEMS AND TRENDS IN MINNESOTA,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 05C.
W70-04270

MANAGING LIVESTOCK WASTES TO CONTROL POLLUTION,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 05C.
W70-04271

5F. Water Treatment and Quality Alteration

REGIONAL CONSTRUCTION REQUIREMENTS FOR WATER AND WASTEWATER FACILITIES.
Business and Defense Services Administration, Washington, D.C.

Available from the US Dept of Commerce, Wash, DC, 20230, price - $0.25. US Department of Commerce, Business and Defense Services Administration, Oct 1967. 35 p, 22 fig, 18 tab, 7 map, 9 ref.

Descriptors: *Water supply, *Waste water (Pollution), *Waste water treatment, *Costs, Construction, Water quality, Construction costs, Installation costs, Maintenance costs, Replacement costs, Obsolescence.
Identifiers: *Water facilities, *Wastewater facilities.

The purpose of this report is to serve as a guide and to assist manufacturers in planning their future production and sales programs. It can also be used to advantage by construction contractors, consulting engineers and federal, state and local planners. This study provides historical data of construction put in place in actual dollars from 1955 through 1966, and a projection of requirements in 1966 dollars from 1967 through 1980. Since World War II the increase in population, with its attendant tremendous urban expansion accompanied by population shifts in the United States, has stimulated a greater demand for public water and wastewater facilities. At 1966 prices, an estimated $66.3 billion must be spent on construction of water ($28.8 billion) and wastewater facilities ($37.5 billion) during the 14-year period 1967-1980. This sum is required to remedy present deficiencies, to make up for obsolescence and depreciation, and to meet increased requirements of a growing population. The increase in water usage and wastewater discharge will require an average annual expenditure at $4.7 billion for the 14-year period for water and wastewater facilities ($2.0 billion and $2.7 billion respectively). This is an increase of approximately 139% of the annual average expenditure over the past 12 years. (Davis-Chicago)
W70-04168

GRAVITY FILTRATION OF ALGAL SUSPENSIONS,
Ontario Water Resources Commission, Toronto. Div. of Research.
R. H. G. Andrews.
Ontario Water Resources Commission, Division of Research Publication No 21, Aug 1968. 41 p, 22 fig, 6 tab.

Descriptors: *Water, *Filters, *Algae, Nuisance algae, Intakes, Sands, Flow rates, Turbidity, Chlorella, Scenedesmus, Euglena.
Identifiers: *Water supplies, Green algae, Head losses, Oocistus, Filtration media, Anthracite, Gravity filters.

This study was concerned with effectiveness of different filter media preventing the clogging of water supplies by algae: Chlorella, Scenedesmus, Oocistus, and Euglena. The dual-media and anthracite filters proved comparatively most effective, but their maximum retention was only 50% of Euglena and 18% of other algae. There was no consistent effect of the rate of flow on algae removed. The use of nephelometric turbidimeter failed to provide a significant correlation between algae counts and recorded turbidities. The conclusion is that gravity filters alone should not be considered for removal of algae from raw water supplies. (Wilde-Wisconsin)
W70-04199

POLICE AND HEALTH REGULATIONS OF FOURTH CLASS CITIES.

Mo Ann Stat secs 79.380, 79.390 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Cities, *Public health, *Diseases, Legislation, Local governments, Parks, Condemnation, Regulation, Water works, Hospitals, Sewers, Conduits, Outlets, Channels, Channel improvement, Wells, Reservoirs, Well regulations, Well permits, Reservoir management, Water supply, Cisterns, Water pollution, Diversion, Obstruction to flow.

The board of aldermen of fourth class cities may make regulations and enact ordinances for the prevention and abatement of contagious diseases within the city. Quarantine laws may be enforced within five miles of the city. The board may purchase or condemn all necessary lands within ten miles of the city for hospital purposes, waterworks, and sewer carriage and outfall. The police jurisdiction of the city shall extend over such land to the same extent as over other city property. The board may establish, alter, and change the channel of watercourses, wall them and cover them over, and prevent obstructions thereon. They may establish and regulate public wells, cisterns, and water reservoirs. They may provide for the filling of such water reservoirs. (Schram-Florida)
W70-04231

REGENERATION OF SPENT GRANULAR ACTIVATED CARBON,
MSA Research Corp., Callery, Pa.
For primary bibliographic entry see Field 05D.
W70-04297

ARTIFICIAL RECHARGE FOR PUBLIC WATER SUPPLIES IN URBANIZED REGIONS,
Technische Hogeschool, Delft (Netherlands). Dept. of Sanitary Engineering.
L. Huisman.

Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 200-212, 1967. 13 p, 17 fig, 2 tab.

Descriptors: *Artificial recharge, *Municipal water, *Water storage, *Water quality, Water treatment, Filtration, Public health, Water purification, Water resources, Water spreading, Aquifers, Permeability, Porosity.
Identifiers: *Netherlands.

Artificial recharge is applied to transform surface water with varying characteristics into groundwater of more constant quality, which will be safe for public supply. The utmost stress is put on the removal of bacteriological pollution, for which purpose the recharge and recovery works are designed and operated in such a way as to avoid short-circuiting as much as possible. This results in a more or less constant detention period for all the water abstracted and consequently variations in physical and chemical characteristics of the raw water are propagated with little or no damping. Input variation, as well as fluctuation in water temperature, could be smoothed out by a different design of the artificial recharge system, promoting a strong variation in detention time and -- if necessary -- even accepting short-circuiting. A few suggestions are given for possible solutions. As an example, the use of water from the River Rhine for public drinking water supplies in the Netherlands is considered. (Knapp-USGS)
W70-04356

CHICAGO'S SOUTH DISTRICT FILTRATION PLANT.
Department of Water and Sewers, Chicago, Ill.

Chicago, City of Chicago Department of Water and Sewers, 1961. 29 p, 25 fig, 3 tab.

Descriptors: *Water treatment, *Water purification, *Filtration, *Filters, *Water supply, *Water works, *Treatment facilities, Chemical precipitation, Coagulation, Chlorination, Sedimentation, Ammonification, Activated carbon, Construction, Construction materials, Construction costs, Intakes, Tunnels.
Identifiers: *Chicago Water Department, *Chicago's South District Filtration Plant.

The publication describes the design, construction and operation of Chicago's South District Filtration Plant which went into full operation in 1947. The plant, located at Lake Michigan near East 79th St., serves about 1,600,000 persons in a 162 Sq. Mi. area. Two raw water intakes are provided--one crib intake located 2 miles offshore, and a direct intake at the lake end of the plant. Water entering the crib intake is conveyed by 14 Ft. and 16 Ft. diameter tunnels located 140 Ft. below lake level. A breakwater was built to protect plant structures from wave action, and a watertight bulkhead was built around the plant area. The mixing and settling basins are of two-story construction. A portion of the filtered water storage is located below the filters. The treatment process consists of prechlorination, addition of activated carbon, coagulation with aluminum sulfate or ferrous sulfate, fluoridation, sedimentation, filtration, and postchlorination with ammoniation. Maximum plant capacity is 640 mgd; 1960 average was 365 mgd. Construction cost, including engineering and supervision, was $27,052,932. One hundred seventy two employees are used to operate the plant. (Poertner-Chicago)
W70-04437

PRODUCTION OF CHANNEL CATFISH (ICTALURUS PUNCTATUS) IN TERTIARY TREATMENT PONDS,
Iowa State Univ., Ames. Dept. of Zoology and Entomology.
Thomas G. Huggins, and Roger W. Bachmann.
Available from the Clearinghouse as PB-190 165, $3.00 in paper copy, $0.65 in microfiche. Iowa State Water Resources Research Institute, Completion Report Project No A-017-IA, June 1969. 119 p, 21 fig, 38 tab, 35 ref. OWRR Project A-017-IA.

Descriptors: *Channel catfish, *Tertiary treatment, *Ponds, Water quality, Temperature, Light penetration, Dissolved oxygen, Ammonia, Nitrates, Nitrites, Phosphates, Chemical oxygen demand, Biochemical oxygen demand, Phytoplankton, Zooplankton, Benthic fauna, Hydrogen ion concentration, Ammonia, Diurnal distribution, Chlorophyll, Chlamydomonas, Chlorella, Copepods, Rotifers, Tubificids, Pollution abatement, Stocking, Midges, Seasonal, Depth, Chemical analysis, Scenedesmus, Euglena, Ochromonas, Nematodes, Mites, Insects.
Identifiers: *Ictalurus punctatus, Ames (Iowa), Ankistrodesmus, Pandorina, Cladocerans, Physa halei, Chironomids, Glyptotendipes barbipes, Chlorogonium, Actinastrum, Golenkinia, Kirchneriella, Micractinium, Oocystis, Pediastrum, Chroomonas, Cryptomonas, Navicula, Nitzschia, Glossiphoniidae, Palpomyia.

A series of four tertiary treatment ponds, studied for water quality improvement and channel catfish production, provided data on water temperature, light penetration, dissolved oxygen, ammonia, nitrate, nitrite, ortho phosphate, chemical oxygen demand, biochemical oxygen demand, phytoplankton, zooplankton, benthic fauna and channel catfish. Thermal and chemical stratification disappeared after installation of an aeration system. Average reduction in nitrate and nitrite concentration from the plant effluent to pond IV was 27% during the 1967 winter and 70% during the 1968 summer. During the 1967 winter a slight increase in ortho phosphate concentration was recorded from treatment plant effluent to pond IV but during the 1968 summer there was a reduction of 48%. Dominant genera were usually Chlamydomonas, Ankistrodesmus, Chlorella, and Pandorina in pond IV. Average concentration of chlorophyll a in ponds III and IV was similar both summers but in ponds I and II much less for the 1968 summer. Cladoceran populations were greater in pond I during the 1968 summer than during the 1967 summer. Chironomids were the dominant organisms in benthos. During the 1967 summer, catfish grew well in ponds III and IV. Catfish survival, growth and production progressively increased from pond I to pond IV. (Jones-Wisconsin)
W70-04445

IMPOUNDMENT DESTRATIFICATION FOR RAW WATER QUALITY CONTROL USING EITHER MECHANICAL OR DIFFUSED AIR PUMPING,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
J. M. Symons, W. H. Irwin, E. L. Robinson, and G. G. Robeck.
J. American Water Works Assoc., Vol 59, No 10, p 1268-1291, October 1967. 20 fig., 5 tab., 19 ref.

Descriptors: *Thermal stratification, *Aeration, *Impoundments, *Reservoirs, *Mixing, *Water quality control, Water quality, Water pollution, Nitrogen, Phosphorus, Air, Phytoplankton, Algae, Efficiencies, Dissolved oxygen, Oxygen, Lakes.

Two methods are compared for artificially destratifying lakes and reservoirs both of which broke up the thermal stratifications pattern in the lakes successfully and improved water qualities. Other conclusions reached were that multiple mixing started in the spring will maintain good quality water in an impoundment, and is superior to a single mixing in midsummer or early fall. Some rise in nitrogen and phosphorus concentrations occurred in surface water during destratification, but the surface population of phytoplankton and the phytoplankton standing crop declined during mixing. Algal populations increased again when mixing stopped. Data taken in this study and from 5 other studies in the literature showed a destratification efficiency ranging from 0.1 to 1.2%, and averaging 0.5%; and an energy input/unit of impoundment water volume ranging from 0.7 to 4.9 kw-hr/acre-ft. and averaging 2 kw-hr/acre-ft. (Novotny-Vanderbilt)
W70-04484

5G. Water Quality Control

PROJECTS OF THE INDUSTRIAL POLLUTION CONTROL (BRANCH FEDERAL WATER POLLUTION CONTROL ADMINISTRATION),
Federal Water Pollution Control Administration, Washington, D.C.
William J. Lacy.
Available from the Clearinghouse as PB 189 766, $3.00 in paper copy, $0.65 in microfiche. Up-dated version of report with same title of August 1969 (See Vol 3, No 6, W70-02885). FWPCA Water Pollution Control Research Report, Jan 1970. 167 p, 9 tab, 4 fig. FWPCA Project 12000---01/70.

Descriptors: *Industrial water, *Water pollution control, Wastewater treatment, *Water reuse, *Water pollution treatment, Industries, Water quality, Water requirement.
Identifiers: Industrial pollution control.

The objective of the industrial pollution control R and D program is to develop and demonstrate the required technology to achieve required degrees of pollution control by lease cost methods for all significant industrial sources of pollution. This report includes summaries of 150 research, development, and demonstration efforts necessary to resolve industrial pollution problems. A total of 1200 program efforts are listed in tabular presentation. These projects include the latest developments in physical, chemical, biological and combinations of treatment methods. It is expected to develop further the cooperation of industry to participate in meaningful pollution abatement demonstrations and to increasingly demonstrate the feasibility of in-plant measures, by-product recovery, and wastewater reuse as methods to abate pollution and to reduce treatment costs. Research through in-house efforts and by contracts to industries and universities are to complete state of the art studies related to treatment and control technology for selected industry groups. Research through in-house efforts and by contracts to industries and universities are to complete state of the art studies related to treatment and control technology for selected industry groups. Industrial wastewaters are to be identified, characterized, quantitized, and classified for all industries of pollutional significance.
W70-04045

DISSOLVED-AIR TREATMENT OF COMBINED SEWER OVERFLOWS, A DEMONSTRATION PROJECT OF A PROTOTYPE TREATMENT PLANT DESIGNED TO TREAT WASTES FOUND AT A COMBINED SEWER OVERFLOW.
Rhodes Technology Corp., Houston, Tex.
For primary bibliographic entry see Field 05D.
W70-04063

DELAWARE RIVER BASIN COMPACT.
For primary bibliographic entry see Field 06B.
W70-04081

WATER QUALITY MANAGEMENT, FIRST ANNUAL REPORT FOR PERIOD ENDING JUNE 30, 1969.
Miami Conservancy District, Dayton, Ohio.

Miami Conservancy District First Annual Report of Water Quality Management, Aug 1969. 97 p, 31 fig, 5 exhibit, 17 tab, 44 ref.

Descriptors: *Water pollution control, *Ohio, Water quality act, Aesthetics, Water quality, Water pollution treatment, Monitoring, Planning, Water management (Applied).
Identifiers: *Miami River (Ohio).

The programs and activities of the Miami Conservancy District are described. The purpose of the District's program is to provide for the evaluation of regional water quality in the Great Miami River basin and for the development of regional programs which will enhance and protect the water and related land resources of the basin. Activities being carried out are the formation and utilization of advisory groups, the establishment and operation of a network for monitoring regional stream water quality, and the evaluation of various approaches to improving water quality, such as stream aeration and low-flow augmentation. The plan also provides for continuing surveillance of stream conditions with appropriate notice to individuals and organizations responsible for activities which degrade stream appearance. Reaches of stream which are maintained by The Miami Conservancy District for flood control purposes are receiving more intensive care directed to improving the appearance of the river channels. (Knapp-USGS)
W70-04096

ACID MINE-DRAINAGE PROBLEM OF THE PATOKA RIVER WATERSHED, SOUTHWESTERN INDIANA,
Indiana Univ., Bloomington.
Don M. Corbett.
Water Resources Research Center Report of Investigations No 4, Indiana University, Oct 1969. 173 p, 4 fig, 2 plate, 4 tab, 10 ref.

Descriptors: *Acid mine water, *Indiana, Water pollution sources, Water pollution control, Water pollution treatment, Acidic water, Neutralization, Data collections, Water quality, Leaching, Sulfates, Chlorides.
Identifiers: Patoka River, Pike County (Ind).

Sources of acid in the Patoka River Watershed, Indiana, were identified and the effect this acid had on the water quality of the Patoka River was determined. The economic development of Pike County and adjacent areas has been stymied for more than 30 years because of an inadequate supply of good quality water. The Patoka River (below the mouth of the South Fork Patoka River during periods of low flow, is too acidic for domestic use. Treatment would be beyond the financial resources of the local economy. Of the 20,000 acres of cast overburden groundwater aquifers in Pike County, less than 4,000 acres produce acidic water. The remaining 16,000 acres produce nonacidic water, most of which is high in sulfate, and in some instances, high in chloride. The acid mine-drainage problem of this area is a creation of past mining operations for coal. Acid contributions from storm runoff are usually many times greater than those from sustained flow, and most generally originate in the compacted 5 to 10% of the areas disturbed by surface mining that accelerate runoff. Stabilization of acidic flows at a reduced level, by eliminating flushout of pollutants in the South Fork Patoka River Watershed, would make feasible the treatment of 5,000,000 gpd. (Knapp-USGS)
W70-04097

INVESTIGATION OF SOME METHODS FOR INCREASING THE DIGESTIBILITY IN VITRO OF MICROALGAE,
Royal Inst. of Tech., Stockholm (Sweden). Div. of Applied Biochemistry.
Gudmund Hedenskog, Lennart Enebo, Jitka Vendlova, and Bohumir Prokes.
Biotechnology and Bioengineering, Vol 11, No 1, p 37-51, 1969. 6 fig, 4 tab, 18 ref.

Descriptors: *Algae, *Microorganisms, Scenedesmus, Proteins, Walls, Structure, Amino acids, Mechanical equipment, Enzymes, Chemical degradation, Vitamins, Cellulose, Chlorella, Peptides, Bacteria, Snails, Weight, Vacuum drying, Boiling.
Identifiers: *Digestibility, *In vitro, In vivo, Ballmill, Meicelase, Hydrogen peroxide, Rats, Trypsin, Scenedesmus quadricauda, Scenedesmus obliquus, Helix pomatia, Chlorella pyrenoidosa, Nitrogen utilization, Roller drying, Spray-dried, Glass beads, Trichoderma, Disintegration.

To increase availability of cell bound protein in Scenedesmus algae, mechanical, enzymatic, and chemical methods of degrading the cell wall structure were investigated. Mechanical treatment involved the use of a ball-mill; algae suspension together with glass beads was milled in a water-cooled chamber equipped with rotating disks. The chemical test included a cellulolytic enzyme (Meicelase) employing hydrogen peroxide. Using batches in the ball-mill experiments a complete disintegration was achieved in a disintegrator. Trials were also performed with a continuous disintegrator and dependence of disintegration on bead size and flow rate studied. Disintegration determined by microscopic cell count was compared to increase of pepsin digestibility. The Meicelase treatment caused a slight increase of pepsin digestibility, measured after 3 hour pepsin incubation. No increase of pepsin digestibility was detected with hydrogen peroxide treatment. After the ball-mill disintegration, 95% of contaminating bacteria were killed and yields of extractable proteins were higher. Capacity of available continuous ball-mills is such that they could be used on a pilot-plant scale and energy cost of disintegration would be of the same magnitude as that of separation. (Jones-Wisconsin)
W70-04184

GEORGIA WATER LAW (WATER POLLUTION IN GEORGIA),
For primary bibliographic entry see Field 06E.
W70-04203

A BOUNTY ON WATER POLLUTERS,
A. R. Roalman.
Water Resources Bulletin, Vol 5, No 2, p 62-65, June 1969. 4 p, 1 ref.

Descriptors: *Water resources development, *Legislation, *Water pollution control, *Pollution abatement, Rivers and Harbors Act, Harbors, Navigable waters, Legal aspects, Government, Water pollution sources, Non-structural alternatives, Environmental sanitation, Remedies.

The Harbor Act of June 29, 1888, as amended on June 7, 1924, could be the most powerful pollution control law on the books. It provides a way for any private citizen to bring an action against almost any water polluter. It includes a stiff fine and a jail sentence for the polluter. It also provides a bounty for the citizen who proves his case. A congressman and a group of New York conservationists have invoked the act in a suit against the Penn-Central Railroad charging pollution of the Hudson River. The Secretary of the Army and the Corps of Engineers of the United States Army are responsible for enforcing the law. The Act originally covered New York Harbor and Long Island Sound. Later amendments expanded it to cover waterways flowing into the Atlantic and the Gulf of Mexico. The most recent amendment extended coverage to the outflow waters of the United States. One contention is that all the navigable waters of the United States are included. The Act strictly forbids the placing, discharging, or depositing, by any process or manner, of refuse, dirt, ashes, cinders, mud, sand, dredgings, sludge, acid, or any other matter of any kind other than that flowing from streets, sewers, and passing therefrom in a liquid state. Another portion of the Act concerns pollution caused by oil spills from ships. (Powell-Florida)
W70-04210

ESTABLISHMENT OF MUNICIPAL SEWER SYSTEMS.
Mo Ann Stat secs 88.832 thru 88.852 (Supp 1970).

Descriptors: *Missouri, *Sewers, *Sewage disposal, *Local governments, Legal aspects, Political aspects, Cities, Sewage, Sewage treatment, Waste water disposal, Wastes, Municipal wastes, Domestic wastes, Municipal water, Environmental sanitation, Treatment facilities, Taxes, Legislation.

Any municipality may establish a general sewer system composed of public, private, district, and joint district sewers. Public sewers shall be established along principal courses of drainage. The municipality may levy a 'special public sewer tax' on all taxable property within the city to pay for construction and maintenance of sewers. District sewers may be established and connected to public sewers upon petition of a majority of the landowners in the district or when the municipality deems such sewer necessary for sanitary reasons. The municipality shall levy a tax apportioning the cost of district sewers among the pieces of ground in the district. Joint district sewers may be established when the municipality deems a sewer in an area encompassing more than one district to be necessary. The municipality may regulate construction of private sewers and shall assume none of the cost thereof. The municipality may condemn and purchase property for construction of sewers. When no bids are offered for sewer construction the city may construct a sewer. (Dye-Florida)
W70-04229

WATER POLLUTION.
Mo Ann Stat secs 204.010 thru 204.180 (1962), as amended, (Supp 1970).

Descriptors: *Missouri, *Water pollution, *Water pollution control, *Administrative agencies, Legislation, Public health, Environmental sanitation, Impaired water quality, Pollution abatement, Pollutants, Pollutant identification, Reasonable use, Riparian rights, Standards, Wastes, Industrial wastes, Sewage, Water pollution treatment, Fish, Wildlife, Recreation, Agriculture, Permits, Water pollution sources, Administrative decisions, Legal aspects.

The state policy toward water pollution is detailed. Pollution is defined as the discharging of sewage or wastes into the state's water so as to make them impure, odorous, detrimental to public health, harmful to fish or wildlife, or detrimental to agricultural, industrial, recreational, or other reasonable uses. Causing pollution is declared a public nuisance and made unlawful. Permits are required prior to discharging sewage or wastes into the state's waters. The Water Pollution Board is authorized to grant and revoke such permits. The Board shall supply technical and scientific information to polluters to aid in eliminating pollution. Hearings and judicial review of Board actions relating to permits are provided. The organization of the Water Pollution Board is outlined. The Board is required to: (1) make surveys to determine the extent of pollution within the state; (2) prepare plans to reduce pollution and prevent further pollutions; (3) establish standards of water purity; and (4) administer the enforcement of pollution laws. The Board may conduct research, cooperate with government agencies, and enter agreements to prevent and control pollution. The Board may investigate violations, institute legal proceedings, make inspections, and represent the state. The powers of drainage and levee districts and the rights of action are not affected by this act. (Schram-Florida)
W70-04237

WATER POLLUTION BY NUTRIENTS-SOURCES, EFFECTS AND CONTROL, PAPERS PRESENTED AT 1966 ANNUAL MEETING OF MINNESOTA CHAPTER SOIL CONSERVATION SOCIETY OF AMERICA.
Minnesota Univ., Minneapolis. Water Resources Research Center.
For primary bibliographic entry see Field 05B.
W70-04266

SETTING WATER QUALITY STANDARDS AND REGULATING NUTRIENT SOURCES,
Minnesota Pollution Control Agency, Minneapolis.

John P. Badalich.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 64-72, June 1969.

Descriptors: *Nutrients, *Regulation, Nitrogen, Phosphorus, Water quality control, Waste treatment, Water quality, Minnesota, Eutrophication.
Identifiers: *Nutrient sources, Stream standards, Effluent standards, Stream uses, US Public Health Service, Water quality standards, Areal nutrient sources.

The definition of an acceptable water quality standard is thought to have instigated all the discussion of standards in the past few years. Basis and methodology for establishing water quality standards for Minnesota are discussed. Application of water quality standards in Minnesota is discussed in terms of stream and effluent standards; specific standards are presented. Regulation of nutrient sources is summarized in terms of point sources and areal runoffs. Areal and agricultural runoff contributes the major portion of nutrients. Nuisance blooms of algae are possible at a phosphorus concentration of 0.01 milligram/liter and 0.3 milligram/liter of nitrogen. Minnesota has a phosphorus standard of 1 milligram/liter, which is considered a temporary economically attainable limit for the present, rather than a protective limit. (See W70-04266). (Bannerman-Wisconsin)
W70-04277

EFFECT OF DESASPIDIN AND DCMU ON PHOTOKINESIS OF BLUE-GREEN ALGAE,
Marburg Univ. (West Germany). Dept. of Botany.
W. Nultsch.
Photochemistry and Photobiology, Vol 10, No 2, p 119-123, 1969. 2 fig, 2 tab, 15 ref.

Descriptors: *Cyanophyta, *Light, *Kinetics, Anaerobic conditions, Argon, Photosynthesis, Air, Light quality, Cycles.
Identifiers: *Desaspidin, *DCMU, Phormidium uncinatum, Phosphorylation, Ferricyanide, Electron transport, ATP, Dark, Phycocyanin, Acceleration, Glycolysis, Carbon dioxide-fixation, Phycoerythrin.

Photokinesis (light accelerated movement) is the result of an increased ATP supply of photosynthetic phosphorylation, whereas movement in the dark is supported by ATP produced by oxidative phosphorylation and, to a minute extent, by anaerobic-phosphorylation coupled with glycolysis. Movement speed may be used to measure the activities of phosphorylation processes within the living cell. Effect of desaspidin and DCMU (3-(3,4-dichlorophenyl-1, 1-dimethylurea) on movement speed in light and dark of the blue-green algae Phormidium uncinatum has been investigated. Desaspidin, which uncouples oxidative phosphorylation and predominantly cyclic photosynthetic phosphorylation, inhibits movement in the dark as well as light, but dark movement is more sensitive. Movement in light is more sensitive under anaerobic conditions than in air. Inhibitory effect of desaspidin is markedly increased by DCMU, which inhibits non-cyclic electron transport and coupled phosphorylation in air as well as under argon. There is no evidence of any photodestruction of desaspidin in air, provided no ferricyanide is present in the medium. These findings are interpreted to confirm the concept of photokinesis and that both cyclic and non-cyclic photophosphorylations supply energy for the movement in blue-green algae. (Jones-Wisconsin)
W70-04293

FACTORS AFFECTING THE USE OF MONOMOLECULAR SURFACE FILMS TO CONTROL OIL POLLUTION ON WATER,
Naval Research Lab., Washington, D.C.
William D. Garrett, and William R. Barger.
Environmental Science and Technology, Vol 4, No 2, p 123-127, Feb 1970. 5 p, 4 fig, 3 tab, 17 ref.

Descriptors: *Water pollution control, *Monomolecular films, *Oily water, Water chemistry, Water properties, Water quality, Surfactants, Thin films, Films, Alcohols.
Identifiers: Oil pollution control.

Under suitable conditions, monomolecular surface films may be used to confine oily pollution on water. Since these materials spread spontaneously into one-molecule-thick layers, very small quantities can be used to treat large surface areas. The surface-chemical characteristics of several potential pollutants were studied to determine their behavior at the air/water interface. A number of monolayer-forming materials with varying surface-chemical properties were examined for their ability to survive at an air/water interface and contain oil films. The following monolayer properties relevant to oil pollution control were determined: the monolayer spreading velocity, the ability to resist and spread against wind, and the thickness of an oil lens supportable by a particular monolayer. Optimum characteristics were demonstrated by 'liquid' water-insoluble monolayers with high film pressures and low oil solubility. Surface films with high spreading pressures will compress thinly spread layers of pollutant oil to lenses 0.5-1.0 cm thick, substantially reducing the area covered by pollution. (Knapp-USGS)
W70-04305

ACID MINE DRAINAGE IN APPALACHIA.
Appalachian Regional Commission, Washington, D.C.

Appalachian Regional Commission Report, 1969. 126 p, 4 fig, 10 plate, 37 tab.

Descriptors: *Acid mine water, *Appalachian Mountain Region, *Data collections, *Surveys, Hydrologic data, Water chemistry, Water quality, Hydrogeology, Water pollution sources, Water pollution effects, Water pollution control, Recreation, Navigation, Water sources, Ecology, Economics.
Identifiers: Acid mine drainage data.

Over the last 100 years, coal mining in the Appalachian Region has caused increased amounts of acid, sediment, sulfates, iron, manganese, and hardness in the Region's streams, thus substantially altering water quality in approximately 10,500 miles of streams,primarily in the northern half of the Region. Three-fourths of the acid streams are in the Susquehanna, Allegheny, Monongahela, Potomac, and Delaware River basins in Pennsylvania, West Virginia, and Maryland. Almost 80% of acid pollution comes from abandoned or inactive mines and over 70% originates in underground mines. Cost and extracted waste disposal considerations limit treatment technology applicable for pollution control to the neutralization processes. A concerted effort over a period of time to abate and control acid mine drainage pollution involves determining priorities, providing funding arrangements, implementing abatement programs, regulating active mining operations, continuing research and development of control and abatement techniques, and adequately considering the interests of the various public and private groups involved. Such an effort, to be successful, requires the full participation of Federal, regional, state and local levels of government as well as the private sector in the affected portions of the Region. (See also W70-04329 thru W70-04333). (Knapp-USGS)
W70-04328

THE IMPACT OF MINE DRAINAGE POLLUTION ON INDUSTRIAL WATER USERS IN APPALACHIA,
Battelle Memorial Inst., Columbus, Ohio.
Ira L. Whitman, Gerald I. Nehman, and Syed R. Qasim.
Appalachian Regional Commission Report on Acid Mine Drainage in Appalachia, Appendix A, 1969. 254 p, 21 fig, 71 tab, 5 append.

Descriptors: *Acid mine water, *Water costs, *Industrial water, *Appalachian Mountain Region, Economics, Water pollution effects, Acidity, Aesthetics, Color, Corrosion, Fouling, Water quality, Water chemistry.
Identifiers: Acid mine drainage costs, Industrial water costs.

Rivers and tributaries draining coal mine regions in Appalachia receive large volumes of acid mine-drainage pollution. The effects of acid mine drainage on industrial water users in Appalachia are discussed and the economic impacts on the region, should reductions in mine-drainage pollution be achieved, are estimated. Sixty-seven manufacturing plants were visited to obtain detailed data on industrial water use, water costs, adjustments to current levels of mine-drainage pollution, and potential savings from pollution reduction. Primary focus of the in-plant interviews included the food processing, paper, chemicals, textiles, primary metals, and stone and glass industries. The greatest savings to industry would be in operating costs, particularly in reduced costs of chemicals used for waste treatment. Other savings would result from reduced maintenance, less frequent replacement of equipment, and in a few cases, lower initial plant investment costs. It is concluded that reduction in mine-drainage pollution in Appalachia would have little impact on the economy of the region itself due to changes in water utilization by industry. Estimates of annual dollar savings to industry from mine-drainage reduction indicate that such savings are but an insignificant fraction of total industrial production costs or sales value. Industry production would not be altered in either volume or composition due to reductions in mine-drainage pollution. (See W70-04328). (Knapp-USGS)
W70-04329

ENGINEERING ECONOMIC STUDY OF MINE DRAINAGE CONTROL TECHNIQUES.
Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.

Appalachian Regional Commission Report on Acid Mine Drainage in Appalachia, Appendix B, 1969. 281 p, 42 fig, 54 tab, 269 ref. ARC Contract No 69-12.

Descriptors: *Acid mine water, *Water pollution control, *Water pollution treatment, *Appalachian Mountain Region, Water costs, Water treatment, Waste water treatment, Acidic water, Iron, Sulfates, Neutralization, Reverse osmosis, Injection wells, Waste water disposal.
Identifiers: Acid mine drainage.

A series of cost curve graphs were developed to serve as a method for determining the costs of applying various techniques of controlling acid mine drainage pollution. Wherever possible, curves have been presented for changes in capital, operating, and maintenance costs where these are dependent upon the scale of application under the varying sets of general conditions characteristic of mine drainage polluted areas in the Appalachian Region. The effectiveness of each of the control techniques was studied in terms of the degree to which mine drainage pollution is controlled, and the quality characteristics of the post-technique water. The techniques in the proposed or experimental stage that offer the greatest promise and thus warrant further research and development are recommended. The recommended techniques are neutralization, reverse osmosis, streamflow regulation, deep well disposal, land reclamation, revegetation, pumping and drainage, water diversion, mine sealing, refuse treatment, and impoundment of acid water. (See W70-04328). (Knapp-USGS)
W70-04330

THE INCIDENCE AND FORMATION OF MINE DRAINAGE POLLUTION IN APPALACHIA.
Corps of Engineers, Cincinnati, Ohio. Office of Appalachian Studies; and Bureau of Mines, Pittsburgh, Pa.

Appalachian Regional Commission Report on Acid Mine Drainage in Appalachia, Appendix C, 1969. 360 p, 77 fig, 2 plate, 50 tab, 306 ref.

Descriptors: *Acid mine water, *Water pollution sources, *Appalachian Mountain Region, *Water chemistry, Acidic water, Chemical reactions, Water pollution treatment, Water quality, Multiple-purpose projects.
Identifiers: Acid mine drainage control.

Mine drainage pollution in Appalachia is generally coincidental with regions that have been or are presently being mined. The worst offending areas are in the old coal fields of West Virginia and Pennsylvania, and in a few areas of southeastern Ohio which have been stripped in recent decades. It appears that the annual acidity load has remained rather stable during the last two decades. However, the rapidly growing U.S. economy requires ever increasing amounts of energy and, at least for the next few decades, coal will provide a large percentage of the needed fuel input. Appalachian states will provide most of the coal. Without effective preventive measures, the detrimental impact of mine drainage effluent on the region's water quality will be much greater in future years. Mine drainage is a solution of mixed salts, predominately sulfates, usually containing silica and sometimes highly charged with dissolved carbon dioxide. Hydrolysis of the dissolved materials in mine drainage in streams forms acid, causing a drop in the stream's pH level. A mine drainage pollution control program should be included in a project whenever the potential benefits are seriously inhibited without abatement. (See W70-04328). (Knapp-USGS)
W70-04331

THE IMPACTS OF MINE DRAINAGE POLLUTION ON LOCATION DECISIONS OF MANUFACTURING INDUSTRY IN APPALACHIA.
Fanus Co., Inc., New York.

Appalachian Regional Commission Report on Acid Mine Drainage in Appalachia, Appendix D, 1969. 317 p, append. ARC Contract No 68-50.

Descriptors: *Acid mine water, *Economics, *Water quality, *Industrial water, *Appalachian Mountain Region, Water costs, Water treatment, Water pollution treatment, Water quality control.
Identifiers: Acid mine drainage costs.

The effect of mine drainage pollution on past decisions by industrial firms to locate (or not to locate) within the Appalachian Region is discussed. Twenty case histories of plant location searches by industries that are larger-than-average users of water are compiled. Markets were an important contributory factor which eliminated Appalachia in nine of the final location decisions. Most of the industries found that abatement of acid mine pollution would have to be 90% or better to influence decisions to locate. Unfavorable location decisions are caused by poor water quality in the textile dyeing, paper, chemical, plastic, and aluminum industries. In many others, acid mine drainage pollution is not an important plant location factor. (See W70-04328). (Knapp-USGS)
W70-04332

IMPACT OF MINE DRAINAGE ON RECREATION AND STREAM ECOLOGY: APPENDIX E. MINE DRAINAGE POLLUTION AND RECREATION IN APPALACHIA.
Nathan (Robert R.) Associates, Inc., Washington, D.C.

Appalachian Regional Commission Report on Acid Mine Drainage in Appalachia, Appendix E, 1969. 114 p, 28 tab, 63 ref, 5 append.

Descriptors: *Acid mine water, *Water pollution effects, *Recreation, *Water costs, *Appalachian Mountain Region, Economics, Water pollution treatment.
Identifiers: Acid mine drainage costs.

Among the detrimental aspects of mine acid drainage is the impairment of outdoor water-based recreational activity. Mine acid pollution can inhibit and may even completely deter the use of natural waters for swimming, water-skiing, or skin-diving, and for both warm and cold water sport fishing. A study was made to estimate the magnitude of the activity loss and the resultant economic (monetary) loss which could result from a failure to abate the mine acid drainage in the polluted areas of Appalachia containing potentially recreational waters. If changes are made in water quality by various degrees of mine acid reduction, a region may be able to realize some or all of the income from the otherwise lost potential recreation expenditure. To the extent that mine acid waste abatement makes it possible to realize the increases in expenditures, these may be viewed as a schedule of opportunity benefits to which the regional income multipliers can be applied. (See W70-04333). (Knapp-USGS)
W70-04333

DELAWARE RIVER BASIN COMPACT (WATER SUPPLY, POLLUTION CONTROL, FLOOD PROTECTION).
For primary bibliographic entry see Field 06B.
W70-04359

BIODEGRADABILITY OF POTENTIAL ORGANIC SUBSTITUTES FOR PHOSPHATES,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
Robert L. Bunch, and M. B. Ettinger.
Proceedings 22nd Industrial Waste Conference, Lafayette, Indiana, p 393-396, 1967. 1 fig, 14 ref.

Descriptors: *Water quality, *Eutrophication, *Detergents, *Phosphates, Chelation, Waste treatment, Aquatic algae, Aquatic plants, Testing, Biodegradation.
Identifiers: *Complexones, *Algal blooms, NTA, EDTA, HEIDA, Lake Tahoe (Calif).

The undesirable eutrophication of waters may be considerably reduced by replacing phosphates in industrial processes and detergents with biodegradable chelating agents, such as nitriloacetic acid (NTA) and hydroxyethyliminodiacetic acid (HEIDA). The use of detergents containing non-phosphate builders is suggested, especially for extreme situations, such as Lake Tahoe. The use of non-biodegradable agents which complex heavy metals will depend upon their effect on waste treatments, softening water, drinking water, and calcium metabolism of man. (Wilde-Wisconsin)
W70-04373

BRIEF TO THE INTERNATIONAL JOINT COMMISSION CONCERNING THE POLLUTION OF LAKES ERIE, ONTARIO AND THE INTERNATIONAL WATERS OF THE ST LAWRENCE RIVER,
Toronto Univ. (Ontario). Great Lakes Inst.
P. H. Jones.
University of Toronto, February 6, 1970. 12 p, 3 fig.

Descriptors: *Lake Ontario, *Lake Erie, *Great Lakes, Detergents, Phosphate, Testing.
Identifiers: St Lawrence River, Heavy duty detergent, Detergent biodegradability tests, Fish toxicity studies, Algae studies, Biodegradable detergent.

Phosphate is the critical nutrient in the fertilization of the Great Lakes, and detergents contribute 1/2 to 2/3 of the phosphates reaching waste treatment plants. A non-phosphate heavy duty laundry detergent has been developed which is comparable in cleaning effectiveness with current products, and would cost no more to produce when economies of scale are achieved. It contains nothing which would upset the natural cycle or create pollution conditions. Biodegradability studies resulted favorably. Other tests are under way. (Powers-Wisconsin)
W70-04378

A RIVER DIES--AND IS BORN AGAIN,
Fred J. Cook.
In: Controlling Pollution, ed. Marshall I. Goldman, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1967, p. 130-138, and New York Times Magazine, April 13, 1965.

Descriptors: *Water pollution, *Financing, *Legal aspects, *Coordination, *Sewage districts, *Sewers, *Sewage treatment, *Sewage, Estuaries, Decision making, Public health, Industrial wastes, Population, Municipal wastes, Fish, Oxygen demand.
Identifiers: *Raritan River, *Middlesex County Sewage Authority, *New Jersey State Health Department, Trunk sewer, Public relations, Compliance powers.

The Raritan River became highly polluted by World War I and was 'dead' by 1928. Under the 'New Deal' sewerage treatment plants were built to rectify this situation. A centralized system was suggested, but separate municipal plants were constructed. By 1940 these plants were obsolete. The industrial and population growth brought on by World War II were phenomenal. By 1950 the river was a controversy again. The Middlesex County Sewage Authority (MCSA) was established by the County. The MCSA had no compliance powers and cooperation was piecemeal. Weakened, the MCSA worked to gain public support. Since communities had built treatment plants only ten to fifteen years earlier, they would be reimbursed for their plant's present value when they joined the MCSA's trunk sewer and treatment system. Within six months the river began to come alive again. Although much improved, the Raritan was a disappointment. Non-MCSA municipalities and industries are to blame. Court action is planned, but will be useless unless the State Health Department is funded sufficiently to prepare a viable case. Public pressure will be necessary for this to occur. (Richmond-Chicago)
W70-04428

EFFLUENTS AND AFFLUENCE,
New England Interstate Water Pollution Control Compact.
Jared E. Hazelton.
In: Controlling Pollution: The Economics of a Cleaner America, ed. Marshall I. Goldman, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1967, p. 91-98, and New England Business Review, June 1965, pp. 2-9.

Descriptors: *New England Interstate WPS Compact, *Interstate compacts, *Sewage treatment, *Water zoning, *Coordination, *Classification, Water supply, Water demand, Planning, Costs, Benefits, Aesthetics, Public health, Federal government, State governments, Local governments, Flood plains.
Identifiers: *Interstate pollution, *Interstate cooperation, *Federal Water Pollution Control Act, *Restrictions, Comprehensive planning.

The river zoning approach used by the New England Interstate Water Pollution Control Compact is described. The responsibility for polluting activities is placed on both municipalities and industries. Various approaches to cleaning up the waterways are discussed: setting minimum standards; building treatment plants; and zoning. The conclusion is that it is best to make decisions on the basis of balancing costs of treatment against the benefits which various water uses bring to the community. However, minimum standards are always invoked to insure public health and aesthetic qualities. The growth of the federal role in water pollution abatement and similar state activities at the state level are discussed in light of the Federal Water Pollution Act of 1956. This legislation is reviewed in terms of its enforcement and financial assistance powers. Finally, concern is voiced that unless comprehensive interstate planning is carried out, the result of water pollution abatement and flood control programs might be the encroachment onto flood plain areas which would better serve as open space. (Richmond-Chicago)
W70-04429

THE GREAT AND DIRTY LAKES,
Gladwin Hill.
In: Controlling Pollution: The Economics of a Cleaner America, ed. Marshall I. Goldman, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1967, p. 43-48, and Saturday Reivew, Oct. 23, 1965.

Descriptors: *Algae, *Industrial wastes, *Municipal wastes, *Great Lakes, *Water pollution, Sewage, Aesthetics, Aerobic conditions, Anaerobic conditions, Water supply.
Identifiers: *Devolution, *Interstate pollution, *Metropolitan areas, Blondin.

The pollution of the Great Lakes is discussed. Focusing on Niagra Falls, the sources of pollution from Duluth to Buffalo are traced. Special attention is given to the Chicago and Detroit metropolitan areas. The Great Lakes are treated as one continuous system and suggests interstate pollution abatement as the only possible recourse, rejecting international efforts as cumbersome and intrastate efforts as ineffectual. While recognizing the municipal waste as a major pollution source, the author concentrates on industrial wastes from the oil, steel, paper, soap, chemical and automotive industries. He cites the Chicago and Detroit metropolitan areas as the main dischargers of ammonia nitrogen, phenols, cyanide, oil, phosphates, chlorides, suspended and settleable solids and nitrogen compound wastes into the Lakes. Chicago's efforts to maintain a usable water supply and Detroit's outdated sewage treatment facilities are also reviewed. The death of Lake Erie is treated along with a discussion of the devolution of aquatic life which accompanied it. The efforts of private individuals and conservation groups and those of various state and federal governments are treated. (Richmond-Chicago)
W70-04430

THE REBIRTH OF A RIVER,
Lee Edson.
In: Controlling Pollution, ed. Marshall I. Goldman, Englewood Cliffs, N.J., Prentice-Hall, Inc., 1967, p. 143-149, and Petroleum Today, Summer, 1966.

Descriptors: *Ohio River, *River basin commissions, *Municipal wastes, *Financing, *Sewage treatment, *Standards, *Local governments, *Water pollution, *Water quality control, State governments, Fishkill, Public health, Monitoring, Coordination, Thermal pollution, Sewage, Oil industry, Coal mine wastes, Chemical wastes.
Identifiers: *ORSANCO, Spills, Paper industry, Metal finishing industry, Steel industry.

Industry's willingness is illustrated to take part in cooperative efforts to develop and then comply with minimum water quality standards. The importance is noted of public support, quoting Abraham Lincoln: 'Public sentiment is everything. With public sentiment nothing can fail; without it nothing can succeed.' ORSANCO's (Ohio River Valley Water Sanitation Commission) history is traced from its conception in 1935, through its inception in 1948, to its success as of 1967. Since 1948, over $1 billion has been spent to treat 99.4 per cent of the effluent discharged into the river. Ninety per cent of these funds came from local, state and industrial coffers; the federal government not being needed to solve local problems. However, the U.S. Army Corps of Engineers, the Public Health Service, the U.S.G.S. and the U.S. Weather Bureau have all contributed to the maintenance of ORSANCO's monitoring efforts. While the job is not complete, the 'oil, chemical, coal, paper, metal finishing and steel companies' have made a major contribution in the ORSANCO success story. Thermal pollution from nuclear plants is seen as a significant threat to the environment. Pleasure craft operators and nuclear plants are blamed for most of the remaining water pollution. (Richmond-Chicago)
W70-04436

THE CHICAGO SEWER SYSTEM, 100 YEARS OF PROTECTING CHICAGO'S HEALTH,
Department of Water and Sewers, Chicago, Ill.

For primary bibliographic entry see Field 08A.
W70-04438

AMINO ACID CHELATING AGENTS IN DETERGENT APPLICATIONS,
Grace (W. R.) and Co., Nashua, N.H. Hampshire Chemical Div.
Robert R. Pollard.
Soap and Chemical Specialties, Vol 42, No 9, p 58-62, 130-135, 1966. 11 fig, 2 ref.

Descriptors: *Detergents, *Soaps, *Chelation, Pollution abatement, Toxicity, Biochemical oxygen demand, Biodegradation, Phenols, Sewage treatment.
Identifiers: *Polyphosphates, Polymeric phosphates, Sodium LAS, NTA, EDTA, Chelating agents.

Toxicological studies, including rats, rabbits, and fish, as test organisms, suggested that nitrilotriacetic acid (NTA), or its trisodium salt NTATS, can advantageously replace some polyphosphates (STPP, TSPP, TKPP) in soaps and detergents. The NTATS is an alkaline material hydrolyzing in water into a weak acid and a strong base, and, in turn, possessing considerable buffering capacity. The salt does not appear to exhibit significant biochemical oxygen demand over periods up to 31 days or inhibit biodegradation of linear alkylsulphonates (LAS) and phenol biooxidation at levels of about 100 ppm. The salt does not influence factors of sewage treatment. The optimum concentration of NTA, combination of NTA with polyphosphates, effect of water hardness, the effectiveness of NTA as a builder of amino oxides and alkyl phosphonic diamides are among several aspects awaiting investigation. (Wilde-Wisconsin)
W70-04456

THE ROLE OF CULTURED POND FISH IN THE CONTROL OF EUTROPHICATION IN LAKES AND DAMS,
Fish Culture Research Training Inst., Malacca (Malaysia).
For primary bibliographic entry see Field 05C.
W70-04467

NATURAL RESOURCE PROTECTION THROUGH SHORELAND REGULATION: WISCONSIN,
Wisconsin Univ., Madison. Dept. of Agricultural Economics.
Douglas A. Yanggen, and Jon A. Kusler.
Land Economics, Vol 44, p 73-86, February 1968. 2 fig, 41 ref.

Descriptors: *Shore protection, *Regulation, *Zoning, Wisconsin, Lakes, Water pollution control, Water resources development.
Identifiers: *Shorelands, University of Wisconsin, County zoning, State zoning.

In August 1966 the State of Wisconsin enacted a law to minimize water pollution and to preserve fish, wildlife, and natural beauty. It prescribes county zoning of the unincorporated shorelands of all navigable waters, with the provision of state level zoning where counties fail to act by January 1, 1968. Shorelands are defined as 1000 feet from lakes and 300 feet from rivers. Small lot sizes and individual septic tanks have led to pollution of wells and surface waters, and overcrowding of the shores destroys scenic beauty. The definition of 'zoning' may include the regulation of water supply, waste disposal, tree-cutting, structure setback from highways and navigable water, filling and grading, and subdivisions; but the interpretation must not lead to the unconstitutional confiscation of private property. A group from the Wisconsin Division of Resource Development and the University of Wisconsin prepared a model shoreland protection approach which attempts to meet the statutory objectives with minimum delay by establishing a development code and a simple districting scheme for the shoreland areas. (Powers-Wisconsin)
W70-04493

SPECIFIC PROBLEMS IN RIVERS: ALGAE IN RIVERS OF THE UNITED STATES,
Public Health Service, Cincinnati, Ohio. Div. of Water Supply and Pollution Control.
C. Mervin Palmer.
Transactions of the seminar on Algae and Metropolitan Wastes, held at Cincinnati, Ohio, April 27-29, 1960, sponsored by Division of Water Supply and Pollution Control and the Robert A Taft Sanitary Engineering Center. Algae and Metropolitan Wastes, U S Department of Health, Education, and Welfare, Division of Water Supply and Pollution Control; and Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio, Technical Report, SEC TR W61-3, p 34-38, 1961. 3 fig, 4 ref.

Descriptors: *Rivers, *Algae, *Sampling, *Mississippi River, *Ohio River, Nuisance algae, Water quality, Sewage effluents, Diatoms, Missouri River, Columbia River, Colorado River, Tennessee River, Hudson River, Delaware River, Water pollution effects.
Identifiers: *River studies, *National Water Quality Network, Algae counts, Plankton analyses, Agricultural runoff, Arkansas River, Merrimack River, Red River, Savannah River, Snake River, Rio Grande River, Potomac River.

Investigation of algae in rivers of the United States have been lacking due to the general impression that they are relatively scarce. However, more data is needed to determine their significance as pollution indicators, stream purifiers, nuisance growths, and food for fish. Basic information should be collected for extended time periods during each month of the year for as many rivers in representative locations as possible. Such data should yield necessary background information for studies and aid in determining effects of particular factors on river biota. Since 1957, the National Water Quality Network program of the Public Health Service has carried on such sampling program for 16 rivers and the Great Lakes. For the first two years the average count per monthly samples was 3,625 algae/milliliter, lowest counts occurring in November, December, and March, highest in April, September, and October. Highest plankton counts occurred in rivers enriched by agricultural runoff and sewage effluents, particularly where toxic industrial wastes were lacking. The same few genera of algae are found to dominate rivers across the country. Two comparison studies at the Robert A Taft Sanitary Engineering Center deal with green algae of the Mississippi and Ohio Rivers and number of genera of diatoms in several river systems. (See W70-04506). (Ketelle-Wisconsin)
W70-04507

ECONOMICS AND POLITICS INFLUENCE POLLUTION ABATEMENT RESEARCH,
Dow Chemical Co., Midland, Mich.
J. B. Hemwall.
Water and Sewage Works, Vol 116, No 6, p 222-225, June 1969. 4 p.

Descriptors: *Economics, *Political aspects, *Water pollution, *Pollution abatement, Value, Costs, Prices, Water treatment, Taxes, Waste disposal, Water pollution control.
Identifiers: Subsidy, Penalties, Social base, Fluid-fluid separation, Solid-fluid separation.

Meeting the research needs in pollution abatement, while necessary, is far from sufficient to get anything accomplished. The literature contains references to unmet research needs and additional information is available from the Federal Water Pollution Control Administration. This discussion, however, is addressed mainly to the influences which make pollution abatement research insufficient--namely, economics, politics and social habits. The author states that the outstanding economic characteristic of water is that it has no value. Its price is quite arbitrary and there is a great deal of federal activity that can be considered a subsidy. The economics of water is even worse after the water has been used. Initially, payment has to be made for the cost of transportation, for whatever treatment is performed, and for the

operation of the system. These items establish a cost, if not a value. Used water has neither value nor cost and there is no economic incentive to clean it up. Suggestions are offered that could improve the economics of water in this area. Other problems of water pollution abatement in the areas of politics and unmet needs are discussed. (Loeb-Rutgers)
W70-04518

WATERCRAFT REGULATION.

Mo Ann Stat secs 306.010 thru 306.310 (1963), as amended, (Supp 1970).

Descriptors: *Missouri, *Boats, *Boating regulations, Legislation, Boating, Water sports, Recreation, Administration, Governments, Legal aspects, Water law, Permits, Wastes, Sewage, Water pollution.
Identifiers: Water toilets.

Every motorboat operated in this state shall be numbered. Issuance and display of registration numbers is regulated. A change in ownership of a motorboat requires issuance of a new registration number. Motorboats registered under a federal number system or a federally approved state system are not required to register, nor are vessels owned by the United States or ships' lifeboats. Motorboats are divided into four classes according to length for purposes of equipment and lighting requirements prescribed by statute. Reckless or drunken operation of motorboats is prohibited. Motorboat regattas and towing of waterskiers are regulated. Operators involved in motorboat accidents are required to aid accident victims. If an accident results in death or property damage greater than $100 the operator must file a report with the Boat Commission created by statute. Boat livery is regulated. Funds collected from motorboat registration shall be used to promote safe boating. Each violation under this chapter is punishable by fine or imprisonment. Marine toilets shall not discharge inadequately treated sewage. All boats are subject to inspection by the Water Pollution Board. No person shall tamper with a boat without the owner's permission. (Dye-Florida)
W70-04535

GENERAL SEWER SYSTEMS FOR FOURTH CLASS CITIES.

Mo Ann Stat secs 88.717 thru 88.740 (1952).

Descriptors: *Missouri, *Sewers, *Sewage disposal, *Local governments, Domestic wastes, Municipal wastes, Sanitary engineering, Sewage districts, Wastes, Waste water disposal, Waste disposal, Cities, Taxes, Financing, Legislation, Legal aspects.

The board of aldermen of a fourth class city may establish a system of public, district, and private sewers, paid for by taxes on all taxable property within the city. District sewers shall be established in districts prescribed by ordinance on petition by a majority of resident landowners within the district or when the board deems such establishment necessary. Taxes shall be levied throughout the district in proportion to the size of each tract taxed. Taxes may be paid in installments. Private sewers are constructed at private expense and regulated by ordinance. Private sewers may be incorporated into the public or district sewer system. The owners of appropriated private sewers shall be compensated. Owners of private sewers dissatisfied with the compensation awarded by the city may petition the circuit court for another appraisal. When the board deems necessary two or more sewer districts may be united into a joint district. The city assumes no liability for construction of private sewers unless the city owns property to be served by the sewer. (Dye-Florida)
W70-04536

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

STOCHASTIC ANALYSIS OF HYDROLOGIC SYSTEMS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-04072

POTOMAC ESTUARY MATHEMATICAL MODEL,
Federal Water Pollution Control Administration, Annapolis, Md. Chesapeake Field Station.
For primary bibliographic entry see Field 05B.
W70-04077

SIMULATION OF DAILY STREAMFLOW,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 02E.
W70-04130

SOME CONSIDERATIONS IN THE ADAPTION OF MARKOV PROCESS THEORY TO RAINFALL-RUNOFF PHENOMENON,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 02A.
W70-04254

A STATISTICAL METHOD TO SEARCH FOR A RAINFALL-RUNOFF RELATIONSHIP,
Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Ingenieria.
For primary bibliographic entry see Field 02A.
W70-04256

ANALYSIS OF 'BLACK BOX' RELATIONSHIP BETWEEN RAINFALL AND RUNOFF,
Pittsburgh Univ., Pa. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-04257

TRANSFORMATION OF DETERMINISTIC AND STOCHASTIC PROCESSES IN HYDROLOGY,
Arizona Univ., Tucson.
For primary bibliographic entry see Field 02A.
W70-04258

A CASE FOR THE SIMULTANEOUS APPLICATION OF DETERMINISTIC AND STOCHASTIC METHODS IN HYDROLOGY,
Manchester Coll. of Science and Technology (England).
For primary bibliographic entry see Field 04A.
W70-04259

COMPUTER MODEL OF CONNECTICUT RIVER POLLUTION,
United Aircraft Corp., East Hartford, Conn. Research Labs.
For primary bibliographic entry see Field 05B.
W70-04302

MATHEMATICAL SIMULATIONS FOR BETTER AQUIFER MANAGEMENT,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
M. W. Bittinger, H. R. Duke, and R. A. Longenbaugh.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 509-519, 1967. 11 p, 4 fig, 13 ref.

Descriptors: *Mathematical models, *Simulation analysis, *Aquifers, *Water management (Applied), Optimization, Groundwater, Computers, Economics, Optimum development plans, Systems analysis.
Identifiers: *Aquifer management.

Manipulation of groundwater storage in conjunction with surface water supplies often requires simultaneous consideration of varied aquifer hydraulic and geometric characteristics, highly variable pumping patterns in time and space, imperfectly connected bodies of surface water, and nondeterministic natural recharge. Legal, economic, and social conditions impose constraints which must be considered in aquifer operation and management. Mathematical modeling and computer analysis techniques allow consideration of these varied and changing factors. Applications to specific aquifer management problems are discussed. (Knapp-USGS)
W70-04364

DIGITAL COMPUTER SIMULATION OF ECOLOGICAL SYSTEMS,
Pennsylvania Univ., Philadelphia. Johnson Research Foundation.
David Garfinkel.
Nature, Vol 194, No 4831, p 856-857, 1962. 5 fig, 1 tab, 10 ref.

Descriptors: *Digital computers, *Simulation analysis, *Systems analysis, *Ecosystems, Analytical techniques, Planning, Food chains, Predation, Grazing, Computer programs, Computer models.
Identifiers: Ecological efficiency, Population dynamics, UNIVAC I, Mass action law, Theoretical ecology, Competitive exclusion principle.

Certain ecological processes are analogous to chemical reactions, describable by the mass action law of chemistry; such similarities permit derivation of methods approximating ecosystems of varying complexity. By representing ecological interactions as chemical reactions, program--devised for UNIVAC I--enables digital computer to write instructions automatically and solve an associated set of differential equations, by numerical methods when presented with a set of initial conditions. Behavior of a theoretical ecosystem is examined where grass is grazed by rabbits, which may be adequately fed or starved, with assumption that starved rabbits die, whereas fed rabbits reproduce. Grass is considered partially unavailable to guarantee its constant influx to system. System is simulated by nine equations, each with a rate constant, and three resultant differential equations. Varying predative efficiency demonstrates ecologically identifiable situations where rabbit population becomes extinct, their numbers attain steady state with time, or are thrown into periodic or damped oscillations. Methods are advantageous because: computer deals with the mathematics; degree of complexity is limited only by speed and memory of computer. Calculations are applicable to theoretical studies or actual situations, as in pest control, but calculability cannot substitute for detailed knowledge of ecosystem involved. (Eichhorn-Wisconsin)
W70-04458

DEVELOPMENT OF A MATHEMATICAL MODEL FOR PREDICTION OF TEMPERATURE IN DEEP RESERVOIRS-PHASE II: HIGH DISCHARGE-VOLUME RATIO RESERVOIRS,
Water Resources Engineers, Inc., Lafayette, Calif.
G. T. Orlob, L. G. Selna, and D. E. Evenson.
Progress Report prepared for the Department of Fish and Game, State of California, by the Water Resources Engineers, Inc., September, 1966. 12 p, 7 fig.

Descriptors: *Mathematical Models, *Temperature, *Reservoirs, *Thermal stratification, Lakes, Diffusion, Heat transfer, Energy transfer, Digital computers, Density currents, California.

The modification of the mathematical model for computation of temperature distribution in reservoirs to make it useful for that of reservoirs which have highly variable horizontal cross-sections or which experience time varying independent inflow and outflow is discussed. The mathematical model is designed to account for net heat flow input from the atmosphere. Using this model, it would be possible to simulate a complete annual cycle of temperature change in an operating reservoir. Certain assumptions, such as the independence of heat flow and reservoir surface temperature, would continue to restrict the versatility of the model. The objective of this report is to give a detailed account of the generalizations made in the one dimensional reservoir temperature model mentioned in the Phase-I report. The model was tested using the data obtained in the Lake Tahoe studies. (See W70-04483). (Novotny-Vanderbilt)
W70-04473

PREDICTION OF THERMAL ENERGY DISTRIBUTION IN DEEP RESERVOIRS,
Water Resources Engineers, Inc., Walnut Creek, Calif.
For primary bibliographic entry see Field 02H.
W70-04476

MATHEMATICAL SIMULATION OF THERMAL STRATIFICATION IN DEEP IMPOUNDMENTS,
Water Resources Engineers, Inc., Walnut Creek, Calif.
For primary bibliographic entry see Field 02H.
W70-04481

DEVELOPMENT OF A MATHEMATICAL MODEL FOR PREDICTION OF TEMPERATURE IN DEEP RESERVOIRS PHASE I: LOW DISCHARGE VOLUME RATIO RESERVOIRS,
Water Resources Engineers, Inc., Lafayette, Calif.
G. T. Orlob, L. G. Selna, and D. E. Evenson.
Progress Report, prepared for the Department of Fish and Game, State of California, July, 1966. 38 p, 9 fig., 1 tab.

Descriptors: *Mathematical models, *Temperature, *Reservoirs, *Thermal stratification, Hypolimnion, Epilimnion, Digital computers, Diffusion, Envirnomental effects, Heat transfer, Energy transfer, Thermocline, Density currents, California.

Development of a mathematical model capable of simulating the natural annual thermal cycle in deep reservoirs is presented. Construction of this model is governed by the physical principles of water movement and energy supply and transfer. The development of the computer program is based on physical representation of a system expressed by Fick's Laws of Diffusion. The other physical principle is a consequence of the force-deformation properties of water. The eddy diffusion coefficient in the hypolimnion is assumed to be virtually constant but attains a maximum at or near the water surface and a minimum at the thermocline. The finite element technique was chosen for the solution on a digital computer. The program was written in the FORTRAN IV computer language, and description of the program and data preparation is included in the Appendix of the report. A test case is described. (See W70-04473). (Novotny-Vanderbilt)
W70-04483

A MATHEMATICAL MODEL OF STREAM TEMPERATURE,
Johns Hopkins Univ., Baltimore, Md.
For primary bibliographic entry see Field 05B.
W70-04487

THE DEMAND AND SUPPLY OF OUTDOOR RECREATION, AN ECONOMETRIC ANALYSIS,
Rutgers - The State Univ., New Brunswick, N.J.
For primary bibliographic entry see Field 06D.
W70-04511

RECREATIONAL TRIP GENERATION, A CROSS SECTION ANALYSIS OF WEEKEND PLEASURE TRIPS TO THE LAKE DISTRICT NATIONAL PARK,
Ministry of Transport, London (England).
For primary bibliographic entry see Field 06D.
W70-04512

ESTIMATION AND IDENTIFICATION OF COBB-DOUGLAS PRODUCTION FUNCTIONS,
Stanford Univ., Calif.
Marc Nerlove.
Rand McNally and Co, Chicago, 1965. 193 p.

Descriptors: *Estimating, Statistical methods, Economic efficiency, Return to scale, Time series analysis, Cross-sections.
Identifiers: *Econometrics, *Estimation, *Identification, *Cobb-Douglas production function, Inputs, Outputs, Marschak-Andrews Approach, Perfect competition, Regulated industries, Klein's approach, Reduced form estimation.

This monograph is concerned with what the economist can say about the physical relationship between the output of a specific commodity and the inputs of the factors used in the production of that commodity. An econometric investigation has its place as a first step toward a full understanding of the relation of the production function. The monograph is restricted mainly to consideration of a single industry composed of individual firms producing a uniform product and using just two factors of production, labor and capital. Complications caused by introducing additional factors of production are discussed in the empirical study presented in chapter 6. Most of the discussion assumes that the relation between the output of the product and the inputs of the factors is linear in logarithms. The Cobb-Douglas production function serves to illustrate problems in determining production functions and some general issues of estimation and identification in econometrics. Several studies are reviewed and attention is drawn to the need for relevant assumptions. Production functions, as well as other econometric methods, have been used extensively in the water area and this discussion presents a comprehensive treatment of the problems and implications of empirical estimation of production relations. (Loeb-Rutgers)
W70-04517

A THRESHOLD REGRESSION MODEL,
Ecole des Hautes Etudes Commerciales, Montreal (Quebec).
Marcel G. Dagenais.
Econometrica, Vol 37, No 2, p 193-203, April 1969, 11p, 25 ref, 4 fig.

Descriptors: *Mathematical studies, Economic evaluation, *Maximization, Time series regression, Model studies, Prices, Economic efficiency, Statistics, Regression analysis.
Identifiers: *Discontinuities, *Steplike time paths, Durable goods, Econometrics.

A special regression model is suggested to analyze economic variables possessing step-like time paths. The dependent variable is assumed not to move until the concerted action of the independent variable and the error term induces it to overcome its reaction threshold. This type of reaction can be applicable in many water resource studies where discontinuities have been observed in the production cost and demand functions. The model is presented and an application to time series data, plant size increases and cross section problems is demonstrated. The article concludes with an explanation of some of the computational problems and the derivation of the likelihood function of the model. (Murphy-Rutgers)
W70-04521

COMPUTATION OF ZELLNER-THEIL'S THREE STAGE LEAST SQUARES ESTIMATES,
Yale Univ., New Haven, Conn.
R. Narayanan.
Econometrica, Vol 37, No 2, p 298-306, April 1969. 9p, 5 ref.

Descriptors: *Economics, *Statistics, *Estimation, Mathematical studies, Model studies, Maximization, Least squares method, Economic evaluation.
Identifiers: *Econometrics, *Three stage least squares, *Identification.

The estimates of the parameters in the group of over-identified equations of a simultaneous equation system are unaffected if the three stage method is applied to this system. This adds to the conclusion reached by others that the large sample efficiency of the estimates is unaffected. This result is established for the general case of a simultaneous equation system subject to linear homogeneous a priori restrictions, whereas many other known properties of the three stage least squares method have been demonstrated only for the special case of simple restrictions on the structural coefficients. The potential use of three stage least squares estimation methods in model formulation and estimation of water resource systems makes this article useful to the water researcher. (Murphy-Rutgers)
W70-04523

ALTERNATIVE APPROACHES TO THE PRODUCTION PROGRAMMING PROBLEM,
Brown Univ., Providence, R.I.
M. J. Beckmann.
Engineering Economist, Vol 13, No 3, p 173-186, Spring 1968. 14pp, 5 tab, 7 ref.

Descriptors: *Linear programming, *Optimization, Economic efficiency, Computers, Marginal cost, Prices, Input-output analysis, Rivers, Canals, Agriculture, Cities, Transportation, Profits.
Identifiers: *Production programming, *Decision making, *Control variables, *Constraints, *Elimination principle, *Substitution method, *Valuation method.

A theory of production is treated in terms of relevant decision variables, rather than inputs and outputs. Linear programming and more general mathematical programming is used to analyze production in terms of control variables. Minimum cost and optimal utilization of inputs are aims of this method. In the example used, all profits are imputed to the single scarce factor. Linear programming is adapted to analysis of the compliated relationships that characterize modern decision-making problems. In the calculations, the constraints are in equation form rather than inequality form for ease of computation, although additional variables must then be introduced. The elimination principle, the substitution method, and the valuation method are all explained as various approaches to production programming. The variety of methods given and the precision offered in these methods of evaluating production phenomena make this article useful to decision-makers in the water resource field. (Murphy-Rutgers)
W70-04529

6B. Evaluation Process

ECONOMICS AND ADMINISTRATION OF WATER RESOURCES,
Colorado State Univ., Fort Collins. Natural Resources Center.
K. C. Nobe.
Available from the Clearinghouse as PB-189 771, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 12 p. OWRR Project A-005-COLO.

Descriptors: *Economic base study, *Contract evaluation, *Recreation liabilities, Regional analysis, Water resources planning, Management and

development, Recreation, Legal liabilities, Liability insurance.

Progress on three separate phases of the research project are outlined: (1) Role of Economic Base Study- A framework for evaluation of recent base studies was developed. Several studies were reviewed to determine the role and delineate cases of superior analysis. Studies were ranked to determine their ability to perform various functions associated with water development. The major role identified for the economic base study in water resource administration settings was to measure the effects of water resources development on the economic base of a region. (2) Evaluation of Special Study Contracts with State Water Board The study focused on an evaluation of special study contracts entered into by the Colo. Water Conservation Board over a 10-year period, 1959-60 - 1967-68. The evaluation included an overall analysis of the Board's expenditures, a review of the individual contracts, an analysis of the contract procedure and an attempt to specify the nature of public benefits derived from these contracts. (3) Recreation Property Owner Liability - A discussion of owners' and possessors' rights, duties and liabilities permits recognition of potential problem areas in management and permissive use by recreationists of private property.
W70-04053

ECONOMICS AND ADMINISTRATION OF WATER RESOURCES,
Colorado State Univ., Fort Collins. Natural Resources Center.
J. Ernest Flack.
Available from the Clearinghouse as PB-189 772, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Fort Collins, Colo, Partial completion Report, June 30, 1969. 16 p, 13 ref. OWRR Project A-005-COLO.

Descriptors: Cost analysis, *Water rates, Water demand, Federal Reclamation Law, *Low flow, Droughts, *Cities, Municipal water, Water works, *Measurement (Metering).

This report presents a summary of the sub-project on Economics and Administration of Water Resources as conducted at the University of Colorado. The purposes and objectives of the research are outlined and abstracts, summaries and conclusions of the various sub-projects are given. A list of reference publications is presented covering the following phases of the research: (a) Total Water Use Analysis by Cities, (b) Federal Reclamation Law, (3) Statistical Analysis of Low Flows, and (d) Effects of Metering on Urban Water Demand.
W70-04054

PATTERNS OF LAND USE CHANGE AROUND A LARGE RESERVOIR,
Kentucky Water Resources Inst., Lexington.
Billy R. Prebble.
Available from the Clearinghouse as PB-189 776, $3.00 in paper copy, $0.65 in microfiche. Kentucky University Water Resources Institute Research Report No 22, 1969. 134 p, 2 fig, 20 tab, 83 ref. OWRR Proj No A-006-KY.

Descriptors: *Land use, *Reservoirs, *Recreation, Water resources development, Land management, Planning, Zoning, Urbanization, Economics.
Identifiers: Reservoir land use.

By examining the spatial patterns of land use changes around a reservoir planners may anticipate windfall profits to landowners, improve environmental quality control, guide the land use planning of surrounding communities, and project future demands for increased services placed on local governments. Several hypotheses concerning the effects of relative location around the reservoir, the effects of relative location, the effects of the characteristics of an individual site, and the effects of road access are tested using analysis of variance and multiple regression. The data used for the analysis is based on Lake Cumberland, a reservoir in Southern Kentucky. (Knapp-USGS)
W70-04067

MULTIPLE PURPOSE RIVER DEVELOPMENT,
Johns Hopkins Univ., Baltimore, Md. Dept. of Sanitary Engineering and Water Resources.
Abel Wolman.
Journal American Water Works Association, Vol 62, No 2, p 71-74, Feb 1970. 4 p.

Descriptors: *Planning, *Water resources development, *Multiple-purpose projects, *Inter-basin transfers, Interstate, Legislation, Optimum development plans, Political aspects, River basin development, Social aspects, Urbanization.
Identifiers: Water resources planning.

The history of water resources research in North America is briefly reviewed. Present trends are discussed and suggestions are made for more efficient ways of utilizing river basin resources. Historically, interest in water was largely local, dominantly single-function, and most often in isolation, even where uses were regional in character. Water development in general was haphazard. Orderless, unintegrated treatment of water problems should no longer be tolerated. The maximum supply of water that can be made regularly available in each drainage area must be put to its best coordinated use. Since 1936, legislation, executive order, and public pressure all give well-supported evidence that the spectrum of multipurpose use has been widely accepted, often practiced in execution, and often operated in fact. The drainage basin, while obviously a good hydrology unit, may be of less value as an economic or social unit. In the last 30 years, planners in the United States have moved steadily from single purpose to multiuse of river systems. For hydrologic purposes the river basin provides sound underpinning. For social purposes, larger projects are often desirable, providing smaller-scale social and hydrological aspects are not overlooked or slighted. Retrospective studies (post-audits) of existing projects should be pursued to provide realistic experience to strengthen future plans. (Knapp-USGS)
W70-04079

DELAWARE RIVER BASIN COMPACT.

Pa Stat Ann tit 32, secs 815.50, 815.101 (1967).

Descriptors: *Pennsylvania, *Interstate compacts, *River basin development, *Delaware River Basin Commission, Water management (Applied), Regulation, Water allocation (Policy), Interstate rivers, Delaware River, New Jersey, Project planning, Administration, Water utilization, Flood plain zoning, Water resources development, Standards, Coordination, Water supply, Water pollution control, Flood control, Watershed management, Hydroelectric power, State governments, Financing, Legal aspects.
Identifiers: *Delaware River Basin Compact.

In order to improve the Delaware River between Philadelphia, Pennsylvania and Trenton, New Jersey, the Department of Forests and Waters is authorized to cooperate with the United States as much as possible and do all acts necessary to effectuate the purpose of improving the river area. The purposes of the Delaware River Basin Compact are to promote interstate comity; to remove causes of controversy; to secure and protect present developments within the states; to encourage and provide for the planning, conservation, and development of the basin's water resources; to provide for cooperation by the signatory parties; and to apply the principle of equal treatment to all water users and to all users of related facilities without regard to established political boundaries. This Compact has an initial duration of 100 years. Commissioners appointed by the President of the United States, and the governors of the signatory states of Delaware, New Jersey, New York, and Pennsylvania, make up the Delaware River Basin Commission. The general areas dealt with by the Compact are: water supply; pollution control; flood protection; watershed management; recreation; hydroelectric power; and regulation of withdrawals and diversions. (Dearing-Florida)
W70-04081

QUANTITATIVE COMPARISON OF SOME AESTHETIC FACTORS AMONG RIVERS,
Geological Survey, Washington, D.C.
Luna B. Leopold.
Report available at no cost from US Geological Survey, Wash, DC 20242. Geological Survey Circular 620, 1969. 16 p, 6 fig, 12 photo, 5 tab.

Descriptors: *Scenery, *Rivers, *Aesthetics, *Natural resources, *Evaluation, Cost-benefit analysis, Parks, Recreation, Conservation, Scenic easements, Wild rivers, Geomorphology.
Identifiers: Quantitative scenery-evaluation.

A preliminary attempt was made to quantify some elements of aesthetic appeal while eliminating, insofar as possible, value judgments or personal preferences. If methods of recording such factors can be developed, the results promise to be a useful, new kind of basic data needed in many planning and decision-making circumstances. Such data would be especially useful when choices must be made among alternative courses of action. Such data would tend to provide a more prominent consideration of the nonmonetary aspects of a landscape. (Knapp-USGS)
W70-04101

POTOMAC-SHENANDOAH RIVER BASIN.
Virginia Dept. of Conservation and Economic Development, Richmond. Div. of Water Resources.

Virginia Division of Water Resources Planning Bulletins No 207-210 (4 vol), 1968. 772 p, 300 plates, 92 tab, 111 ref, 2 append.

Descriptors: *Water resources development, *Planning, *Virginia, Hydrogeology, Rivers, Economics, Water requirements, Water supply, Water quality, Streamflow, Water yield, Water management (Applied).
Identifiers: Shenandoah River, Potomac River.

The purpose of this study by the Virginia Division of Water Resources for the Board of Conservation and Economic Development is to re-examine the Potomac-Shenandoah Basin in light of its latest growth, to project the economy of the area to the year 2020, and to determine the quantitative and qualitative water needs of the area for the future as well as for the present. A firm program for development and use of the waters of the basin is also presented. The reports of the study will be contained in six volumes. Volume I is an introductory volume, Volume II is an economic base study of the basin. Volume III contains a hydrologic analysis of the basin to include a study of surface water, groundwater, and meteorology. Volume IV presents the quantitative and qualitative water resource requirements in the basin. (Knapp-USGS)
W70-04111

DELAWARE RIVER BASIN COMPACT (POWERS AND DUTIES OF THE COMMISSION).

Pa Stat Ann tit 32, sec 815.101, Art 1 thru 3 (1967).

Descriptors: *Pennsylvania, *Interstate compacts, *Delaware River Basin Commission, *River basin development, Project planning, Coordination, Administrative agencies, Legal aspects, Conservation, Water law, Federal government, Federal-state water rights conflicts, Water resources development, Equitable apportionment, Water allocation (Policy), Diversion, Prior appropriation, Adminis-

tration, Standards, Research facilities, River forecasting, Use rates, Delaware River.
Identifiers: *Delaware River Basin Compact, *Comprehensive plan.

The Commission is the develop plans and projects relating to the water resources of the Basin. The Commission has the power, in accordance with the doctrine of equitable apportionment, to allocate the Basin's waters to and among the signatory states, and to impose conditions and release requirements related thereto. The Commission is also empowered to plan, construct and operate any projects or facilities to accomplish the purposes of this Compact. It may establish standards for all projects and facilities that affect the Basin's water resources, including water and waste treatment plants, recreational facilities, trunk mains for water distribution, local flood protection works, small watershed management programs, and groundwater recharging operations. In addition, the Commission may: conduct and sponsor research on water resources; compile and coordinate systematic stream stage and groundwater level forecasting data; conduct special groundwater investigations; prepare and publish information with respect to the water problems of the Basin; negotiate for finances; and fix or alter rates for the use of facilities which it owns or operates. (Dearing-Florida)
W70-04134

ECOLOGY: ITS PLACE IN WATER MANAGEMENT.
Michigan Univ., Ann Arbor. School of Natural Resources.

Water Spectrum, Vol 1, No 1, p 10-14, Summer, 1969. 5 p.

Descriptors: *Ecology, *Environment, Natural resources, *Water management (Applied), Air pollution, *Water resources development, Public opinion, Water pollution.
Identifiers: *Water resources management.

The last few years have seen a new emphasis on ecology in the management of natural resources. While ecology does not provide a master key for resource planning and management, failure to give attention to the interrelations among living organisms and their environment in the development and use of resources has had some unfortunate consequences. Evidence is accumulating that ecological information is as important an input in almost everything we do in the resources field as are economics and engineering. Increasingly, we are finding intolerable the deterioration of air and water, the marring of landscape, and the limited use of resources that preclude other highly valued uses. People are asking what sequence of changes will our developmental actions cause, and what indirect effects will these have on our environment. Few of the conditions that we now find undesirable, even intolerable, are actually new. What has happened is that pollution, loss of natural scenery, and preemption of the use of particular resources have occurred until a threshold of public awareness has been reached. More people are now perceiving clearly the trends of environmental change, earlier unnoticed, and are bringing pressure on public agencies and private firms to mend their ways.
W70-04138

REGIONAL CONSTRUCTION REQUIREMENTS FOR WATER AND WASTEWATER FACILITIES.
Business and Defense Services Administration, Washington, D.C.
For primary bibliographic entry see Field 05F.
W70-04168

METROPOLITAN AREA DEFINITION: A REEVALUATION OF CONCEPT AND STATISTICAL PRACTICE,
Chicago Univ., Ill. Dept. of Geography.
Brian J. L. Berry.

Available from US Bureau of the Census, Wash, DC, 20233, price - $0.50. US Bureau of the Census, Working Paper 28, 1969. 45 p, 20 fig, 91 ref.

Descriptors: *Planning, Cities, Urbanization.
Identifiers: *Metropolitan water resources, *Standard Metropolitan Statistical Areas, *Functional Economic Areas, *Consolidated Urban Regions.

A fundamental problem in metropolitan water resources is the establishment of the planning area. To this end, this study of metropolitan area definition is particularly useful to the water resource planner and manager. The purpose of this study is to conduct an examination of existing principles of area classification for Standard Metropolitan Statistical Areas, and an examination of alternate criteria in order to formulate new principles of area classification. The following steps to revise metropolitan area definitional practice in 1970 were recommended: (1) county building blocks or equivalent units be retained as the basis of any area classification, in all parts of the country; (2) county-to-county commuting data be the basis of the classification of counties into functional economic areas; (3) Functional Economic Areas (FEA) be delineated around all central counties satisfying Standard Metropolitan Statistical Area (SMSA) population criteria and in addition be created for smaller regional centers of population 25,000 to 50,000 in less densely populated parts of the country; (4) where significant cross-commuting takes place, FEA's be merged by the creation of a consistent set of Consolidated Urban Regions (CUR); and (5) consideration be given, for neatness of social accounting, to allocating all unallocated counties to one of the FEA's or CUR's on the basis of additional criteria or regional interdependence. (Davis-Chicago)
W70-04171

THE ECONOMICS OF NATURAL DISASTERS: IMPLICATIONS FOR FEDERAL POLICY,
Douglas C. Dacy, and Howard Kunreuther.
The Free Press, New York, NY, 1969. 270 p, 59 tab, 15 fig, 3 append.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, *Flood plain insurance, Flood damage, Institutional constraints.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

This book consists of essentially a series of arguments for the development of a comprehensive disaster insurance system as an alternative to the present paternalistic Federal policy. The reason given for the increasing role of government in disaster relief is the absence of adequate insurance coverage to homeowners and businesses in hazard-prone areas. The economics of disaster are divided into three parts: (1) statistical evidence on the increasing cost of natural disasters; (2) empirical evidence on short-term recuperation behavior; and (3) capital and labor needs facing disaster areas. Examined also is the Federal government role in providing disaster relief to the private sector ranging from the offering of low-interest loans from the Small Business Administration (SBA) for the replacement or repairing of damaged homes and businesses to the National Flood Insurance Act of 1968. The authors contend that the passage of the Flood Insurance Act is a step in the right direction but are critical of the fact that it only applies to flood disasters. (See also W70-04173 thru W70-04181). (Starr-Chicago)
W70-04172

THE COST OF NATURAL DISASTER IN THE UNITED STATES,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy, Chapter 1, p 3-30, The Free Press, New York, NY, 1969. 10 tab, 3 fig.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, *Flood plain insurance, *Flood damage.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

The threat from violent acts of nature has changed within the past century from an expectation of significant loss of life to an expectation of significant loss of property. This reversal of the life-property loss relationship is a consequence of advancing civilization: (1) the fact that man has built up his physical environment at a rapid rate; and (2) advances in meteorology and communications have made it possible to give ample warning to population of imminent disasters. A figure conceded to be an understatement (since it is only an estimate and one made in 1956) is that the average damage to the United States from hurricanes, floods, tornadoes and earthquakes has exceeded $600 million annually. This figure does not include other cyclonic, non-cyclonic storms, tidal waves, fires, droughts, freezes and rainstorms. The detailed statistical work in this book covers the period from 1925-1964. Yet 1965, which is not included, was the worst year in U.S. history, from the point of natural disasters and its cost to the nation. For the purpose of determining costs of disasters by region, the United States is divided into six fairly large regions: (1) Northeast; (2) Southeast; (3) Western; (4) South Central; (5) North Central; and (6) Ohio Valley. A section on immediate postdisaster estimates indicates that actual losses usually run about one-third of the figures given in the first estimates immediately following a disaster. The effects of such overstatements are: (1) makes it appear that recovery was much faster than it actually was; and (2) makes it easier politically for the Federal government to disperse aid more generously. (See W70-04172). (Starr-Chicago)
W70-04173

RELIEF IN NATURAL DISASTERS,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy. Chapter 2, p 31-57, The Free Press, New York, NY, 1969. 5 tab, 3 fig.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, Flood damage, *Institutions.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

The purpose of this chapter is to demonstrate quantitatively the extent of the socialization of disaster costs and qualitatively how the process of Federal aid is becoming institutionalized. While the cost of natural disasters has risen rapidly the amount of financial aid to disaster victims has grown even faster and reflects a new social attitude. A section of this chapter is devoted to organizations providing assistance. Until the early fifties the major disaster relief agency in the United States was the American National Red Cross. Within the past fifteen years the Federal government has assumed a leading role; some fifty Federal agencies, bureaus and offices are involved in domestic relief. Aid to both the public and private sector is provided by the Federal government. U.S. top laws also provide another source of relief to private citizens. An analysis of statistical evidence indicates that Federal participation has increased markedly during the sixties; and a review of recent legislation indicates that Federal participation is not likely to be reduced in the future. This change in the Federal government's role is attributed to and seen to be consistent with its growing concern and involvement with problems of welfare. (See W70-04172). (Starr-Chicago)
W70-04174

ECONOMIC THEORY AND NATURAL DISASTER BEHAVIOR,
Douglas C. Dacy, and Howard Kunreuther.

In: The Economics of Natural Disasters: Implications for Federal Policy, Chapter 3, p 58-78, The Free Press, New York, NY, 1969. 2 tab, 4 fig.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation Federal policy, *Flood damage, Rehabilitation.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

This chapter is concerned with a theoretical analysis of behavior following natural disasters. It is divided into two sections: (1) the economic choices facing the community immediately following a disaster; and (2) the long-term recovery phase that returns a community to its predisaster level. The problems of information and communication immediately after a disaster are analyzed. Since usually only incomplete information exists, the decision maker is forced to make a decision without really having a choice of alternatives. The prime concern of decision makers in disaster-torn areas is to obtain as many emergency supplies as possible. They cannot calculate the economics of shortage/storage cost ratios; they must concern themselves with supply and demand problems. Using concepts from the decision-making process in a firm, the authors illustrate how a better priority scheme for emergency shipments could be developed with improved information on damage and requirements. In terms of short-term recovery, post disaster needs can then be met more easily and at a lower cost. In terms of the most efficient long-term recovery, labor and outside aid in the rebuilding sector should be devoted to those capital goods whose marginal productivity is highest. (See W70-04172). (Starr-Chicago)
W70-04175

PROBLEMS OF INFORMATION AND COMMUNICATION,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy. Chapter 4, p 81-101, The Free Press, New York, NY, 1969.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, *Institutions, Flood damage, Institutional constraints.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

Differentiated in this chapter on organizational behavior in a disaster are those events which have a warning period (e.g., hurricanes, floods), from those with minimal notice (e.g., tornadoes) or from those with none at all (e.g., earthquakes). Efficient action after a catastrophe is often hampered by what the author calls 'convergence behavior'--the mass movement of messages, supplies and people toward the stricken area. The effects of the uncertainty caused by organizational problems and convergence problems in specific disasters are analyzed and recommendations are made for alleviating the problems. The analyses of specific disasters and actions taken in these disasters cover: (1) Hurricane Carla, 1961; (2) Waco and San Angelo Tornadoes, 1953; and (3) Alaska Earthquake, 1964. In order to reduce the problems caused by convergence behavior certain suggestions are given: (1) the establishment of a central office where people may register their names and whereabouts, thereby eliminating many telephone calls; (2) a telephone line linking the office with hospitals to permit rapid communication of fatalities and injuries; (3) establishment of a priority system for incoming phone calls so that lines are kept open for emergency groups; (4) creation of a central supply clearing house to handle the deluge of clothing, food and unsolicited supplies coming into the disaster area; and (5) delaying public announcement of a disaster to the rest of the nation for several hours so as to avoid convergence problems caused by curious outsiders. (See W70-04172). (Starr-Chicago)
W70-04176

SHORT-RUN SUPPLY AND DEMAND PROBLEMS,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy, Chapter 5, p 102-120, The Free Press, New York, NY, 1969. 5 tab.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, *Flood damage.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

This chapter deals with the short-run problems of resource allocation following a serious disaster, i.e., food and housing, with specific reference to the Anchorage, Alaska disaster and other disaster experiences. The authors contend that most problems of supply and demand are short-term in nature because of the large amount of aid coming from outside the disaster area. Also, post disaster behavior by individuals, who operate in an altruistic fashion, serves to limit the shortages and thereby tends to keep prices lower than they would be in a regular short supply and large demand market. The authors point out the advantages of stockpiling items to handle emergency problems. While housing is not an item that can be stockpiled, actual experiences indicate that most disaster victims are usually placed in homes of friends, relatives or magnanimous community individuals by the first evening after the disaster. The consequence of this fact is that rents usually do not rise after a disaster strikes an area. (See W70-04172). (Starr-Chicago)
W70-04177

PLANNING FOR RECOVERY: THE SPECIAL PROBLEM OF DAMAGE ASSESSMENT,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy, Chapter 6, p 123-140, The Free Press, New York, NY, 1969. 9 tab.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, *Flood damage.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

Assessing the value of physical damage to a disaster area constitutes one of the most difficult problems for a community. Dollar value must be quoted in order to qualify as a Federal disaster area and be eligible for aid under P.L. 875. Little information is available on what cost criteria are the bases for such damage estimates. Also, the unit of analysis is a critical factor in interpreting damage reports and in understanding the meaning of the word 'disaster.' The authors distinguish between three categories of losses: (1) losses to the public sector, e.g., sewer, electricity, telephone, Federal, state and local structures and roads; (2) losses to the private sector; e.g., physical damage to homes and businesses, and indirect economic losses as a result of the curtailment of businesses or a lower level of business operations; and (3) shortfall of revenue, or the decline of state and Federal government receipts from various tax and levies. An analysis of damage estimates and expenditures following the Alaska earthquake indicates that there is a tendency to overestimate damages during the period immediately following a disaster. This pattern is consistent with what has also occurred in other disaster areas; initial figures are almost twice as high as final damage estimates. (See W70-04172). (Starr-Chicago)
W70-04178

RECONSTRUCTION AND ECONOMIC DEVELOPMENTS FOLLOWING A DISASTER,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy, Chapter 8, p 152-182, The Free Press, New York, NY, 1969. 9 tab, 2 fig.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, *Flood damage, Intangible benefits.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

It is difficult to measure exactly the progress made in the recovery period after a disaster strikes a community, and this is particularly true in the private sector. Data are not available which sort out rebuilding as a result of a disaster from overall construction activity. Activity in the public sphere is more predictable since special reports are likely to exist on work performed by Federal agencies. This chapter describes the recovery progress in Skopje, Yugoslavia following the earthquake in 1963 and compares the restoration rate for public facilities there with the rate in Anchorage, Alaska. Described also are post disaster economic improvements due to technological innovations as well as social and political factors. The empirical evidence indicates that a community may benefit economically from a disaster as a result of the rapid inflow of capital for rebuilding purposes and the adoption of technological innovations to meet crisis situations. Cited also are examples of indirect benefits to regions as a result of the physical effects of the disaster: (1) a tornado in Topeka in 1966 carried out a patch almost identical to one proposed by the city for a new superhighway; and, (2) fishing after hurricane Carla was better as a result of the cleansing of the coral reefs by the surging waters. (See W70-04172). (Starr-Chicago)
W70-04179

THE COST OF FEDERAL RELIEF,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy, Chapter 11, p 222-228, The Free Press, New York, NY, 1969. 3 tab.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, Taxes, Compensation.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

The cost to Federal agencies of providing technical assistance, equipment, materials and essential services to a stricken area is relatively low. The most costly type of assistance is a grant given under P.L. 875 to restore public facilities. The type of aid constitutes a transfer payment--from one group of people to another and must eventually be paid for in full out of taxes. Another kind of transfer payment is the loss in Federal revenue due to the tax write-off provisions. A third kind of transfer is that which results from low interest rate loans from the Small Business Administration. The authors assume that: (1) sixty to eighty per cent of total disaster losses pertain to private property; (2) sixty to eighty per cent of private property is not insured; and (3) the tax rate applicable on casualty write-off is between 15 and 25 per cent. On the basis of these assumptions, the authors contend that loss in Federal revenue would vary between 5.4 and 16 per cent of the total estimated disaster losses, or an average estimate of 10 to 11 per cent. The forecast of future annual Federal cost for the next decade in present disaster programs is estimated to be an average of $92 million. (See W70-04172). (Starr-Chicago)
W70-04180

THE NEED FOR COMPREHENSIVE DISASTER INSURANCE,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy, Chapter 12, p 229-261, The Free Press, New York, NY, 1969. 3 tab.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, Flood plain insurance, Compensation.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

Specific criticisms are made against the equity of the current Federal system of disaster relief: (1) low-interest SBA loans or outright grants are only given to areas classified by the Federal government as a disaster area or to areas covered by special congressional legislation; (2) the Federal policy tends to reward the imprudent rather than the prudent individual; and, (3) Federal relief does nothing to discourage individuals from moving into disaster-prone regions, e.g., flood plains. An analysis of current disaster insurance policies is given which indicates the insurance industry's lack of coverage against various natural disasters. The conclusions reached about the rationale behind the insurance industry's position are: (1) companies encourage individuals to take out insurance policies if there is a small risk of large-scale damage; (2) insurance companies willingly provide coverage against a natural disaster, such as a tornado, that could potentially affect any part of the country. The relatively low premiums of many are used to pay for the high damage of a few; (3) insurance companies are concerned with their public image and, therefore, are willing to provide earthquake insurance, if requested to do so; and (4) until this year companies have opposed flood insurance because of the relative certainty of the event in particular regions and the assumption that only individuals in those hazard-prone areas would be interested, thereby causing unusually high rates for the insurance. (See W70-04172) (Starr-Chicago)
W70-04181

WISE USE OF FLOOD PLAINS.
For primary bibliographic entry see Field 04A.
W70-04213

DELAWARE RIVER BASIN COMPACT (WATER SUPPLY, POLLUTION CONTROL, FLOOD PROTECTION).

Pa Stat Ann tit 32, sec 815.101, Art 4 thru 6, (1967).

Descriptors: *Pennsylvania, *Interstate compacts, *Water pollution control, *Flood protection, River basin development, Water management (Applied), Delaware River Basin Commission, Dams, Interstate rivers, Water supply, Surface waters, Groundwater, Regulation, Reservoirs, Storage, Regulated flow, Assessments, Sanitary engineering, Coordination, Treatment facilities, Classification, Warning systems, Delaware River, Waste treatment.
Identifiers: *Delaware River Basin Compact.

The Commission is empowered to develop and implement plans and projects for the use of the Basin's water for domestic, municipal, agricultural and industrial water supply. For this purpose, the Commission may construct, acquire and operate dams, reservoirs and other facilities for utilization of water resources and regulation of the use thereof. The Commission may survey and investigate, and acquire, construct, and operate projects and facilities to control potential pollution and abate existing pollution of the Basin's water resources. The Commission may classify the waters of the Basin and establish standards for treatment of wastes. The signatory states, in order to prevent pollution, agree to enact legislation to enable the maintenance of the Basin's waters in a satisfactory condition. The Commission may also plan, construct and operate projects and facilities for flood damage reduction. The Commission is to create standards relating to the nature and extent of the uses of land in areas subject to flooding. The Commission is empowered to acquire interests in land within the area of a flood plain for the purpose of restricting its use so as to minimize the flood hazard. (Dearing-Florida)
W70-04359

DELAWARE RIVER BASIN COMPACT (WATERSHEDS, RECREATION, HYDROELECTRIC POWER, FINANCING, GENERAL PROVISIONS).

Pa Stat Ann tit 32, sec 815.101, Art 7 thru 14 (1967).

Descriptors: *Pennsylvania, *Watershed management, *Hydroelectric power, *Financing, Interstate compacts, Withdrawal, Interstate rivers, Delaware River Basin Commission, Projects, Erosion control, Runoff, Soil management, Forest management, Recreation, Wildlife management, Recreation facilities, Dams, Diversion, Administration, Transmission (Electrical), Water shortage, Permits, Regulation, Capital, Delaware River.
Identifiers: Intergovernmental relations, Comprehensive plan, Delaware River Basin Compact.

The Delaware River Basin Commission is to promote sound practices of watershed management in the Basin, including projects and facilities to retard runoff and water flow and prevent soil erosion. The Commission is to provide for the development of water related public sports and recreational facilities. The waters of the Delaware River and its tributaries may be impounded and used by or under authority of the Commission for the generation of hydroelectric power. The Commission may regulate and control withdrawals and diversions from surface and groundwaters of the Basin. Various rules are established for the purpose of avoiding conflicts of jurisdiction. The procedures and limits for capital financing are provided. The Commission is to adopt, and may review and revise, a comprehensive plan for the immediate and long-range development and use of the water resources of the Basin. The Commission shall annually adopt a water resources program based upon the comprehensive plan. The Commission has the power of condemnation to accomplish the purposes of the Compact. (Dearing-Florida)
W70-04361

RATIONAL UTILIZATION OF MEXICO'S WATER RESOURCES (IN SPANISH),
Secretaria de Recursos Hidraulicos (Mexico).
Oscar Benassini.
Comite Nacional Mexicano para el Decenio Hidrologico Internacional, Memoria 1966-1967, 1968. p 1-27, 5 fig, 7 tab.

Descriptors: *Water resources development, *Mexico, *Planning, *Water conservation, Water demand, Population, Political aspects, Social aspects, Agriculture, Industrial water, Optimum development plans, Legal aspects, Arid lands, Water pollution, Irrigation water, Municipal water, Multiple-purpose projects, Beneficial use, Surface-groundwater relationships.

The growing world-wide problems of water scarcity are discussed and applied to Mexico. While there would seem to be a sufficient supply of water, irregular seasonal and geographical distribution of rainfall refute this supposition. Baja California, the northern tier of provinces and the north-central bolson are arid regions lacking sufficient water supply. Even in areas blessed with abundance of water, concentration of population and industry are now creating scarcity and pollution. Planning is now being done to make the best possible use of all available water for each region, with emphasis upon enterprises which will least contaminate or withdraw water supplies. The Plan Hidraulico de Mexico encompasses a fundamental objective-nationwide distribution of water resources by means of dam construction and water transfer. Public dissemination of conservation information and legal restraints are also envisioned. (Moore-Arizona)
W70-04408

FLOOD PLAIN MANAGEMENT STRATEGY: AN ANALYSIS,
Chicago Univ., Ill. Center for Urban Studies.
John R. Sheafer.
Proceedings of the Fourth American Water Resources Conference, November 18-22, 1968. p. 255-262, 1 tab.

Descriptors: *Methodology, *Planning, *Management, *Flood plains.
Identifiers: *Flood plain management, Flood plain information, Product orientation, Process orientation, U.S. Army Corps of Engineers.

Flood plain management has become a generally accepted strategy for reducing flood losses and achieving a proper use of the flood plain. It is a complex strategy which is frequently oversimplified and unduly limited when discussed. Flood plain management is a multiple means, single purpose effort that is an integral part of the comprehensive planning process. Success in a flood plain management effort is related to the degree of active participation by local interest groups--financial, professional, occupants and services. These interest groups allocate the flood plain resource in response to a variety of forces--some of which encourage more intensive use of the flood plain and some which tend to inhibit use. Current governmental efforts to achieve a proper use of flood plains have been characterized by low interaction with management interests and a product (flood plain information) orientation. It is suggested that flood plain management efforts would be enhanced, if federal efforts achieved a higher degree of interaction with local interests and there was a shift from product to process orientation. (Davis - Chicago)
W70-04424

AMENITY RESOURCES FOR URBAN LIVING,
Arthur A. Atkisson, and Ira M. Robinson.
In: The Quality of the Urban Environment, ed. Harvey S. Perloff (Baltimore: Johns Hopkins Press, 1969). p. 179-201, 3 tab, 29 ref.

Descriptors: *Social values, *Environment, *Methodology, Planning, Management, Social aspects, Urban sociology, Social needs, Attitudes, Aesthetics.
Identifiers: *Amenity resources, *Public policy, Amenity response system.

The clarification of the concept of amenities and a better understanding of what might be called the amenity management process can contribute to public policy in the environmental area. It is suggested that responses to amenities make up one of the outputs derived from man's environmental system; that these outputs can be 'managed'; and that decisional criteria and management systems can be developed to accomplish this task in a rational and socially responsible manner. Amenities are finally taken to be those stimuli which lead to feelings of comfort, pleasure or joy. Utilizing this definition a simple amenity response system is described. Five major components of this system are identified: (1) the amenity stimulus generator or precipitant; (2) the respondent; (3) the amenity; (4) the amenity response; and (5) the potential disamenities. The operation of this system is investigated in discussions of amenity responses and respondents, economic and political responses to amenities; and amenities, disamenities, and their precipitants. The demand for amenities and the amenity decision system are also investigated. With regard to the use of this type of analysis for environmental planners and managers, it is concluded that given equivalence in the economic potential of resource areas competing for development, such development should occur last in that area which exhibits the greatest amenity potential and in which the projected pattern of development would most adversely affect the area's amenity potential. (See also Vol. 2, No. 24, Field 6B, W69-10206). (Davis - Chicago)
W70-04425

REVIEW AND INTERPRETATION OF EXPERIENCES IN WATER RESOURCES PLANNING,
Pennsylvania State Univ., University Park. Inst. of Public Administration.
Irving K. Fox.
In: Intergovernmental Relations in Water Resources Planning, Seminar Preparation, June 2-

6, 1969, Presented by the Institute of Public Administration, Pennsylvania State University, Conducted for the Corps of Engineers, p. 05-32, (1969).

Descriptors: *Planning, *Water resources development, River basin development, Decision making, Administrative decisions, Administration.
Identifiers: *Public policy, *Water resources planning, River basin planning, Public involvement, Administrative efficiency, Value optimization.

Water resources planning is reviewed over two periods, pre-World War II and post World War II. From an examination of pre-World War II water resources a number of general observations can be drawn. First, one is struck by the dynamic nature of the task that river basin planners are expected to perform. Second, certain features of the water planning situation appear to have become well established: (1) water development will continue to include a large measure of public involvement; (2) decisions regarding water development and use will not be entirely governmental decisions; (3) providing substantial subsidies to the beneficiaries of water resources development appears to be a well-established policy; and (4) the legislative branch appears limited in its ability to represent all interests concerned with highly subsidized water development programs. Third, most of the plans for water resources development in this country have been associated with broad public policy considerations. Since World War II, water resources planning has struggled with several problems. First, there is a lack of consensus as to the objectives of river basin planning. Second, a number of federal agencies have come to have independent, major interests and responsibilities in the water resource field. Third, state and local levels of government were taking a growing interest in water development decisions. The post war approaches to water resources planning are then appraised in light of two criteria, administrative efficiency and value optimization. (Davis - Chicago)
W70-04426

ECOSYSTEM SCIENCE AS A POINT OF SYNTHESIS,
For primary bibliographic entry see Field 06G.
W70-04433

THE CHALLENGE OF GROWTH: A STUDY OF MAJOR COUNTY AND REGIONAL PARK NEEDS.
Saint Louis County Planning Commission, Mo.

St. Louis County Planning Commission, St. Louis, Mo., July 1965. 43 p, 4 tab, 5 map, 46 photo.

Descriptors: *Recreation demand, Land use, Scenic highways, Camping, Swimming.
Identifiers: *Regional parks, *Open space, *St. Louis County (Mo).

Because of the past rapid growth and urbanization of St. Louis County, decisions must be made in advance of further urban development regarding allocation of land for public parks and outdoor recreation facilities. It is estimated that the population of St. Louis County will attain a total of one million persons by 1970 and an estimated 1,175,000 persons by 1980. On the basis of these figures and on the basis of studies conducted for the county, a proposal has been made for a system of approximately 6,000 acres of major county parks and a total of at least 45,000 acres of regional parks. All of the creeks and streams are the primary drainage channels for St. Louis County and a recommendation is made to protect them from encroachment by any type of intensive development. The suggested implementation of this plan includes Federal, state and county coordination. (Starr-Chicago)
W70-04435

AN APPRAISAL OF A LAKE MICHIGAN SITE FOR CHICAGO'S THIRD AIRPORT.
Department of Public Works, Chicago, Ill.
For primary bibliographic entry see Field 04C.
W70-04439

CHAPTER 6: FUTURE STUDIES.
Department of Public Works, Chicago, Ill.
For primary bibliographic entry see Field 04C.
W70-04443

THE OPPORTUNITY COST OF DISPLACED PRIVATE SPENDING AND THE SOCIAL DISCOUNT RATE,
Grinnell Coll., Iowa.
Robert M. Haveman.
Water Resources Research, Vol 5, No 5, p 947-957, October 1969. 11 p, 6 tab, 19 ref.

Descriptors: *Investment, *Cost-benefit analysis, *Capital investment, Risks, Government, Economics, Costs, Gross National Product, Prices, Taxes, Finance, Interest rate.
Identifiers: *Opportunity costs, *Social discount rate, *Social time preference, *Empirical estimation, Shadow prices, Rate of return, Public expenditures.

This paper first presents the major contending arguments in the debate on the social discount rate concept and its empiric estimation procedure. The different concepts on this important issue are the social time preference position, the preferred opportunity cost position and the real cost of borrowed funds. The author presents his arguments for favoring the preference opportunity cost position and the ways in which this position differs from the others is described. An estimate is then made of the opportunity cost of displaced private spending using the empiric framework implicit in the preferred social discount rate concept. The implications of the social discount rate for public investment in the water resource area make this article of interest to the water resource planner. (Murphy-Rutgers)
W70-04516

FORECASTING PRODUCT CONSUMPTION WITH COMPUTERS,
Long Island Univ., Brooklyn, N.Y.; and Long Island Univ., Greenvale, N.Y. C. W. Post Coll.
Richard J. Ward.
Engineering Economist, Vol 10, No 3, p 1-22, Spring 1965. 22 p, 5 tab, 1 fig.

Descriptors: *Forecasting, *Computers, *Oil, Statistics, Statistical methods, Regression analysis, Least squares method, Energy, Economics.
Identifiers: *Product consumption, Standard error, Trend.

The analysis presents a possible approach to forecasting petroleum--and, by implication, other product consumption with the assistance of computers. As distinct from an end-use method, where elaborate efforts are made to estimate consumption on the basis of a forecast of the units which consume the product, the method developed here relies more upon statistical measures. The technique requires only rudimentary knowledge of statistical and economic relations and it is argued here that the essence of good forecasting is to keep the forecaster's philosophy, moods, normative judgments or vested interests at the barest minimum, and to allow the facts and statistical analysis to carry as much of the forecasting burden as possible. Forecasting techniques have been used extensively in the water area and this article is of general interest to water use studies. (Loeb-Rutgers)
W70-04519

THE RATE OF RETURN AND ASSESSMENT OF RISK,
California Univ., Los Angeles.
J. Morley English.
The Engineering Economist, Vol 11, No 3, p 1-12, Spring 1966. 13 p, 5 ref.

Descriptors: *Risks, *Interest rate, Investment, Costs, Economics, Mathematical studies, Profits, Capital, Management, Inflation, Growth rate.
Identifiers: *Rate of return, *Discount rate, Time scale, Utility functions, Dividends.

In conventional evaluation of investment alternatives some index of desirability must be established. Whatever this index, the basic concept requires discounting future dollars at some acceptable rate of return. Risk is often considered by an arbitrary selection of a high rate of return. The author derives a general expression for an interest rate or internal rate of return for use in evaluation of a single investment, in context with the business as a whole. This provides a rational basis for selecting a suitable rate of return for each investment project to be considered. The use of the suggested approach gives different rates of return for projects involving different risks. It shows how size of investment will affect the required rate of return and explains the time relationship to be considered. The importance of the rate of return in considering alternative water resource investments makes the article valuable to the water resource planner. (Murphy-Rutgers)
W70-04520

OPTIMAL GROWTH AND INVESTMENT ALLOCATION,
Harvard Univ., Cambridge, Mass.; and Brandeis Univ., Waltham, Mass.
Sanjit Bose.
The Review of Economic Studies, Vol 35, No 104, p 465-480, October 1968. 16 p, 3 fig, 8 ref, 2 append.

Descriptors: *Investment, Capital.
Identifiers: *Optimal growth, *Investment allocation, Capital accumulation, Infinite horizon case, Finite horizon case.

The optimal programme of capital accumulation is examined in a two sector (consumption and investment) model of growth where the margin of decision is the allocation of investment between the two sectors. This is done by assuming that capital, once installed in a sector, cannot be used in the other, or that investment is irreversible, and by abstracting from labor as a primary output. The resulting production model is well known. The main significance of the model lies in bringing out the limitations imposed upon the choice of current output composition by the inherited structure of capital. The Ramsey approach of optimal savings is adopted in this paper. The optimal growth properties for the infinite and finite horizon cases are examined and some mathematical proofs are given in the appendices. This model has potential application problems in the public good area in general and the water area in particular where investment is irreversible. (Loeb-Rutgers)
W70-04526

WATER RESOURCES DEVELOPMENT, PLANNING, ENGINEERING AND ECONOMICS,
Manitoba Univ., Winnipeg.
Edward Kuiper.
Washington, DC, Buterworth Inc, 1965. 483 p.

Descriptors: *Water resources development, *Planning, *Engineering, Economics, Hydraulics, Hydraulic structures, Flood control, Irrigation, Navigation, Water supply, Benefits, Costs, Dams, Spillways, Interest, River systems.
Identifiers: River system development, Water power, Present value, Annuities.

This book deals with the problem of developing a river system for the greatest benefit of the people that live in its drainage basin. Chapter 1 discusses the different aspects that have to be taken into consideration when planning the water resources development of a drainage basin. Chapters 2 to 5

deal with basic engineering subjects such as hydrology, hydraulics, river morphology, and hydraulic structures. Chapters 6 to 10 deal with the main components of river development: flood control, water power, irrigation, navigation, and water supply. The discussions in these five chapters center mainly around the question of how to make the best use of available water supplies; or conversely, how much water control and supply is required to obtain a certain objective. Chapter 11 pertains to the economic analysis that must be applied to alternative water development plans in order to find the one that will yield the greatest benefits. (Loeb-Rutgers)
W70-04527

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

PATTERNS OF LAND USE CHANGE AROUND A LARGE RESERVOIR,
Kentucky Water Resources Inst., Lexington.
For primary bibliographic entry see Field 06B.
W70-04067

PRELIMINARY DETERMINATIONS OF HYDROBIOLOGICAL CONDITIONS IN THE VICINITY OF THE PROPOSED JETPORT AND OTHER AIRPORTS IN SOUTH FLORIDA, JULY 1969,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 04C.
W70-04078

ECONOMIC THEORY AND NATURAL DISASTER BEHAVIOR,
For primary bibliographic entry see Field 06B.
W70-04175

PLANNING FOR RECOVERY: THE SPECIAL PROBLEM OF DAMAGE ASSESSMENT,
For primary bibliographic entry see Field 06B.
W70-04178

THE COST OF FEDERAL RELIEF,
For primary bibliographic entry see Field 06B.
W70-04180

CHAPTER 5: COST.
Department of Public Works, Chicago, Ill.
For primary bibliographic entry see Field 04C.
W70-04442

FINANCIAL MANAGEMENT OF A WATER UTILITY,
Pate, Hirn and Bogue, Inc., Detroit, Mich.
Stuart H. Bogue.
American Water Works Association Journal Vol 60, No 3, p 267-272, March 1968. 6 p.

Descriptors: *Public utility, *Planning, *Financing, *Management, Demand, Water supply, Budgeting, Government, Political aspects, Investment, Interest rate, Debt, Bonds.
Identifiers: *Program development, *Record keeping, *Special assessments.

Water utilities have inadequate funding for operating a proper system. Some water utility expenses are outlined and three examples are given of successful and unsuccessful water utility management. The means of financing are explained with the emphasis on the different types of bond financing. The successful financial management of a water utility involves proper planning, thorough record keeping and careful decisions. The necessity of running a water utility on a sound basis to meet the increasing demands of its customers is stressed throughout. (Murphy-Rutgers)
W70-04513

PUBLIC ECONOMICS,
Oslo Univ. (Norway).
Leif Johansen.
Amsterdam, North-Holland Publishing Co, Chicago, Rand McNally and Co, 1965. 367 p.

Descriptors: *Taxes, Prices, Economics, Employment, Stabilization, Profit, Credit, Debt, Interest rate, Demand, Loans, Costs, Income, Depreciation, Welfare, Investment.
Identifiers: *Public finance, *Targets, *Instruments, *Macroeconomics, *Fiscal policy, *Public debt, *State budget, *State accounts, *Collective consumption, Public sector, Economic theory, Preference function, Private consumption, Collective wants, Economic growth, Income distribution, Price level.

The book treats economic theory in its relation to the problems of public economy and lays emphasis on principles and applications of theory rather than on description. As such, a complete description of national institutions, fiscal system and policy, and any systematic comparison between countries has been avoided. Facts and figures from Norway and other countries are used mainly to clarify points of principle, and to illustrate the practical importance of the problems which are treated. Simple economic models are employed in the book. A prior knowledge of some basic macro-economic theory and economic welfare theory is recommended. References to literature are given. The theoretical economic problems of water resources are contained in the public finance area and this book will be of aid to the researcher concerned with the underlying economic theory of public goods and public finance. (Loeb-Rutgers)
W70-04514

THE EFFECT OF FINANCIAL INDUCEMENTS ON THE LOCATION OF FIRMS,
Kentucky Univ., Lexington; and Rutgers - The State Univ., New Brunswick, N.J.
William J. Stober, and Laurence H. Falk.
Southern Economic Journal, Vol 36, No 1, p 25-35, July 1969. 11 p, 3 tab.

Descriptors: *Sites, Investment, Model studies, Costs, Taxes, Income, Interest rate, Capital, Labor.
Identifiers: *Financial inducement, *Analytical model, Investment decision, Lease payment, Least cost.

Despite the proliferation of state and local inducements to industrial development, little has been written on their observable or potential influence on location decisions. Generalizations regarding the importance of many other factors controlling the choice of location and analysis of replies to questionnaires submitted to inducement recipients dominate discussions of this matter and point to the uninformative and questionable conclusion that financial inducements are at best a marginal factor in the selection of a location. However, such variables as the growth in the size of firms receiving inducements suggest that financial inducements may indeed be an effective means of attracting industry. The purpose of this paper is to employ an analytical model to isolate the variables that determine the effectiveness of financial inducements. To this end, the investment decision and its relevance to locational choice is examined. Financial inducements are also incorporated into the model and their effect on relative costs determined. Finally, the model is more completely specified and numerical results are presented for representative cases. This paper has potential interest in the water area with respect to attracting water using industries and to assisting water supply developments. (Loeb-Rutgers)
W70-04515

THE OPPORTUNITY COST OF DISPLACED PRIVATE SPENDING AND THE SOCIAL DISCOUNT RATE,
Grinnell Coll., Iowa.
For primary bibliographic entry see Field 06B.
W70-04516

NEW PRICE POLICIES FOR MUNICIPAL WATER SERVICE,
Indiana Univ., Bloomington.
Jerome W. Milliman.
American Water Works Association Journal, Vol 56, No 2, p 125-131, February 1964. 7 p, 5 ref.

Descriptors: *Marginal cost, *Water rates, *Pricing, *Economic efficiency, *Municipal water, Peak loads, Economic analysis, Joint costs, Separable costs, Fixed costs, Public utilities, Total cost, Investment.
Identifiers: *Cost-classification, *Equal-price rule, *Price discrimination.

Not enough thought has been given to the pricing principles and policies which should govern the efficient use and development of municipal water service. The tradition of low prices for municipal water service should be broken and attention should be given to better application of economic principles in the design of water rate schedules. The underlying principles important for economic efficiency are that consumers served under identical cost conditions should be charged equal prices and that waste service should be priced in such a way that the prices charged each class of service should equal the marginal costs of serving that class. The defect in much of the principles underlying water rates (i.e. that prices should cover the costs distributed to each class of user) is explained along with the applicable concepts of joint and separable costs. A conclusion is made that the present rate structure tends to generate inefficiency and waste of resources. (Murphy-Rutgers)
W70-04522

WATER UTILITY COST TRENDS,
Dade County Water and Sewer Board, North Miami Beach, Fla.; Whitman, Requardt and Associates, Baltimore, Md.; and Cast Bay Municipal Utility District, Oakland, Calif.
For primary bibliographic entry see Field 03D.
W70-04524

COMPARISON OF COSTS OF REMOTE CONTROL AND MANUAL OPERATION,
Gary-Hobart Water Corp., Gary, Ind.
Harry D. Harman.
American Water Works Association Journal, Vol 58, No 1, p 152-156, January 1966.

Descriptors: *Operating costs, *Profits, *Public utilities, Statistics, Economic feasibility, Investment, Engineering, Flow rates, Water quality, Management.
Identifiers: *Labor costs, *Remote-control equipment, *Telemetering equipment.

The article relates the possibilities inherent in telemetering and remote control equipment in the distribution system of water utilities for the purpose of increasing net profits and rates of return by lowering labor costs. The article tells of the experience of a new plant which was designed to minimize maintenance and operating costs and to use any and all tools that appeared to the economically sound. Several of these tools are described in the report and it was found that significant savings were realized. However, it was felt that the advantages and economics of remote-control operation would not be fully realized until further additions are made to the plant. (Murphy-Rutgers)
W70-04528

6D. Water Demand

THE CRITICAL BALANCE: SUPPLY VS DEMAND IN WATER USE,
Geological Survey, Washington, D.C.
C. Richard Murray.
Groundwater Resources Institute Quarterly, Vol 2, No 2, p 14-15, Winter 1969. 2 p, 1 fig, 1 tab.

Descriptors: *Water utilization, *Water supply, *United States, Consumptive use, Water reuse,

Economics, Water resources development, Groundwater, Surface waters, Water costs, Withdrawal, Recharge, Water balance.
Identifiers: Water demand-use relations.

Water supply-water use relationships in the U.S. are briefly reviewed. In 1965, 85% of U.S. water consumption took place in the relatively arid 17 Western States - where only a quarter of the country's supply is found. Increased dependability of supply generally can be obtained through water control measures, such as constructing reservoirs, controlling evaporation, or artificially recharging groundwater aquifers. Withdrawal of fresh ground and surface water in the 48 conterminous states in 1965 was 310 bgd, or approximately three-fourths the dependable fresh supply. Consumption was 77 bgd, about one-fifth the estimated dependable supply. All fresh-water withdrawals in the 17 Western States amounted to about 130 bgd, compared to about 150 bgd for the estimated dependable supply. Consumption amounted to about 66 bgd - 45% of the dependable supply. West of the Mississippi, only the Pacific Northwest has a very favorable supply-demand ratio. Low consumptive use and suitability of discharge water for reuse are important factors in determining to which use the water will be put as the competition for available supply increases. (Knapp-USGS)
W70-04319

QUANTITATIVE ANALYSIS OF WATER RESOURCES IN THE ALBUQUERQUE AREA, NEW MEXICO; COMPUTED EFFECTS ON THE RIO GRANDE OF PUMPAGE OF GROUND-WATER, 1960-2000,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02F.
W70-04392

WATER FOR THE CITIES--THE OUTLOOK,
Geological Survey, Washington, D.C.
William J. Schneider, and Andrew M. Spieker.
Available free of charge from US Geological Survey, Washington, DC, 20240. Geological Survey Circular 601-A, 1969. 6 p, 5 ref.

Descriptors: *Urbanization, *Water distribution, Short-term planning, Water resources development, Treatment facilities, Cities.

Water resources are adequate to meet the anticipated future needs of cities. The demands for urban water, however, will place a heavy strain upon existing systems. Present city problems vis-a-vis water have been the result of overtaxed collection, storage and distribution systems. The governing criteria for most cities in solving their water problems have been short-range ones based upon 'crisis' reactions and minimum costs. Future development of water resources will have to consider regional demands and resources because of: (1) the rapid expansion of urban areas and the concomitant juxtaposition of units of governments; (2) overlapping political jurisdiction; and (3) competing demands for the water resource. (Starr - Chicago)
W70-04423

THE DEMAND AND SUPPLY OF OUTDOOR RECREATION, AN ECONOMETRIC ANALYSIS,
Rutgers - The State Univ., New Brunswick, N.J.
Charles J. Cicchetti, Joseph J. Seneca, and Paul Davidson.
New Jersey, Bureau of Economic Research, 1969. 310 p, 16 fig, 18 tab, 43 ref, 2 append.

Descriptors: *Theoretical analysis, *Demand, *Supply, *Recreation, Statistical methods, Model studies, Least squares method, Regression analysis, Statistical models, Recreation facilities, Planning, Estimating.
Identifiers: *Econometrics, *Socioeconomic characteristics, Mixed goods, Public goods, Private goods, Theoretical model, Reduced form, Two step technique, Identification, Bias, Heteroskedasticity, Probit analysis, Generalized least squares, Empirical model, Conditional probability, National Recreation Survey.

A theoretical analysis is presented of the private and public components of outdoor recreation and formulates the qualitative and quantitative characteristics of outdoor recreation as a commodity. An extension of a Musgrave implied mixed good analysis is used as the theoretical framework of the study. After determining the nature of the outdoor recreation good, a theoretical model of demand and supply is formulated using the results of the mixed good analysis. A discussion is presented pertaining to the econometric problems involved in such a study. A two step, conditional probability sub-sample activity day approach is used to examine 24 outdoor recreation activities in the empirical model. The 1965 National Recreation Survey and an inventory of recreational facilities, substitute goods, complementary goods and socioeconomic characteristic found in each county and state for each of the 2194 sample persons supplied the data. From the empirical model an applied model useful for planners at various governmental levels is determined. The final chapter presents an example of its use along with policy recommendations. The vital role of water resources in outdoor recreation and the potential benefit magnitudes of recreation activity in water projects make this article of interest to the water researcher. (Loeb-Rutgers)
W70-04511

RECREATIONAL TRIP GENERATION, A CROSS SECTION ANALYSIS OF WEEKEND PLEASURE TRIPS TO THE LAKE DISTRICT NATIONAL PARK,
Ministry of Transport, London (England).
N. W. Mansfield.
Journal of Transport Economics and Policy, Vol 3, No 2, p 152-164, May 1969. 13 p, 1 map, 7 tab, 5 ref, 1 append.

Descriptors: *Demand, Recreation, Cross-sections, Costs, Regression analysis, Elasticity of demand, Time.
Identifiers: *Recreational trip generation, *Pleasure trips, *Lake district, Traffic data, Day visitors, Half-day visitors.

The paper attempts to analyze the demand for day and half-day pleasure trips to a holiday area, by means of a model describing the generation of trips to alternative recreation facilities and holiday resorts. The main purpose of the paper is to make a cross-section analysis of a single year's traffic data in order to determine how much of the observed variation in trip demand during a single year can be attributed to a few simple factors affecting relative journey costs. The small sample size of the original data meant that only 15 separate observations of trip volumes were available. The author therefore, suggests that the quantitative results should be interpreted as only general indications of the responsiveness of demand to changes in the variables considered. This methodology might well be used to analyze day pleasure trips to water recreational areas in the United States. (Loeb-Rutgers)
W70-04512

AN INDUSTRIAL WASTE GUIDE TO THE COTTON TEXTILE INDUSTRY.
American Association of Textile Chemists and Colorists, Durham, N.C.

American Association of Textile Chemists and Colorists, National Stream Sanitation Committee and National Technical Task Committee on Industrial Wastes, Public Health Service publication 677, 1959, 23p.

Descriptors: *Cotton, *Sludge Disposal, *Filtration, *Neutralization, *Remedies, *Aeration, Waste water disposal, Waste water treatment, Activated sludge, Lagoons, Separation techniques, Chemical precipitation.
Identifiers: *Biological oxidation, *Slashing wastes, *Dyeing wastes, *Desizing wastes, *Scouring wastes, *Equilization, *Chemical oxidation, Trickling filters, Waste volume reduction, Process modification, Recovery (Wastes), Substitution of chemicals.

This publication is intended to assist operators and managers of cotton textile plants to analyze and solve their waste problems. A description of cotton processing and the sources of pollutants are given. A format for plant analysis discusses and recommends the following: (1) determine the magnitude of the waste problem; (2) find in-plant methods to reduce waste volume or polluting effects-for example, by re-use of water, segregation of wastes, lowering the amounts of process chemicals used, recovery and re-use of chemicals, substitution of chemicals, process modification, or simple good housekeeping; (3) determine the maximum waste load the receiving stream can accept; (4) consider the feasibility of combined treatment with domestic sewage; (5) determine which treatment method gives the best, most economical results. Methods discussed are the separation and differential treatment of wastes, equalization and storage, screening and mechanical filtration, aeration, neutralization, chemical precipitation, and chemical or biological oxidation. A bibliography is included. (Sheffield-North Carolina State Univ)
W70-04541

AN INDUSTRIAL WASTE GUIDE TO THE SYNTHETIC TEXTILE INDUSTRY,
American Association of Textile Chemists and Colorists, Durham, N.C.
Arthur L. Smith.
American Association of Textile Chemists and Colorists Committee of Stream Sanitation Technology, National Technical Task Committee on Industrial Wastes, United States Public Health Service, Washington, D.C., 1965, 23 p, 9 figures, 6 tables, 9 references, Public Health Service Publication No. 1320.

Descriptors: *Separation techniques, Waste treatment, Industrial wastes, Remedies, Biological treatment.
Identifiers: Synthetic fibers, Dyeing wastes, Rayon, Acetate, Polyamides, Polyolefins, Polyesters.

This publication summarizes waste problems associated with processing synthetic fibers and suggests methods of analysis and solutions for the problems. Pollutants from processing rayon, acetate, polyamides, acrylic, polyester, and polyolefin fibers include oils, detergents, finishing wastes, scouring bath wastes, dye wastes, and toxic compounds. Wastes should be checked for toxic materials that might be immune to treatment, discharge load should be determined from in-plant measurements and BOD in the stream should be checked under varying conditions. Two solutions to a waste problem are discussed: (1) reduction of waste through process control, good housekeeping methods, chemical substitution and recovery of components, and (2) treatment of wastes by solids separation or biological treatment. A bibliography is included. (Sheffield-North Carolina State Univ)
W70-04542

6E. Water Law and Institutions

PHYSICAL, LEGAL AND ECONOMIC ASPECTS OF ASSESSMENT OF COSTS AMONG DRAINAGE DISTRICTS: LEGAL PHASE,
Iowa Univ., Iowa City.
N. William Hines, and Frank W. Pechacek, Jr.
Available from the Clearinghouse as PB 189 767, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Iowa State Water Resources Research Institute, Dec 31, 1969. 77 p. OWRR Project B-005-IA.

Descriptors: Watershed management, *Legal aspects, Small watersheds, Land use, *Surface drainage, Supervisory control, *Costs.

Discusses the related problems of multi-purpose versus single purpose districts, and the allocation of costs and benefits. An intoductory background on allocation of costs reviews judicial development of the common law, common energy rule, the civil law rule of natural drainage, the reasonable use rule, and state statutes creating drainage districts. A more specific analysis of Iowa districts observes the piece-meal development of too many districts, often at cross-purposes or duplicative, and laboring under an inherently inequitable system of cost allocation based on the theoretically appealing economic benefit concept. The current legal apparatus is defined as archaic in terms of present population and technological demands. Recommends 'multi-purpose' approach to drainage management, which is joint participation by both upper-land and bottom-land owners with special emphasis upon use of soil-conservation and water-retention structures by the upper-land owners.
W70-04047

SOME ASPECTS OF THE WATER RESOURCES DEVELOPMENT IN INTERNATIONAL RIVER BASINS,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
F. E. Schultze, and Ch. A. P. Takes.
Int Inst Land Reclam Impr, Annu Rep, p 5-11, The Neth, 1968. 7 p.

Descriptors: Compacts, Watersheds (Basins), Planning, International waters, Project planning, Policy matters, Foreign countries.
Identifiers: *Developing countries, *International river basin, Chad Republic, Mekong River Project, International projects.

Some aspects of international projects are discussed, with special reference to developing countries where outside technical and financial assistance is needed for designing and constructing basinwide water resources systems. Observations deal mainly with the organizational and operational aspects of the problem and reflect the work of the Chad Basin Commission and the Mekong Committee. To guarantee the most efficient use of water resources of a river basin, a basinwide approach to development is needed. When the basin falls under the jurisdiction of different countries, such an approach is more complicated because some specific and inevitable difficulties are encountered. These problems should be recognized and measures should be taken to reduce them. Two main factors that could reduce the difficulties are: (1) a powerful, well-staffed, and well-equipped administrative force; and (2) well-defined action programs. Much depends on the desire of participating countries for cooperation, and on an understanding that communal effort, rather than a shortsighted clinging to direct national interests, will lead to better results for all. (USBR)
W70-04141

RELIEF IN NATURAL DISASTERS,
For primary bibliographic entry see Field 06B.
W70-04174

PROBLEMS OF INFORMATION AND COMMUNICATION,
For primary bibliographic entry see Field 06B.
W70-04176

NAVIGATION: WATER TRANSPORTATION.

N H Rev Stat Ann secs 270:1 thru 270:30 (1966), as amended, (Supp 1967).

Descriptors: *New Hampshire, *Boats, *Boating regulations, *Navigation, Permits, Administrative agencies, Boating, Recreation, Administrative decisions, Taxes, Legal aspects, Inspection, Legislation, Safety, Equipment, Buoys, Navigable waters, Public utilities, Transportation, Inland waterways, Public health, Assessments, Rates, Government finance.
Identifiers: *Registration, *Common carriers.

The Director of Safety Services is given power to: (1) inspect all boats operated on public waters; (2) supervise navigation safety and aids; (3) regulate the operation of all boats; (4) license specified boat personnel; (5) suspend boat registration for certain violations; and (6) regulate and license all proposed boat races. Registration of all boats and outboard motors is required. Fees are collected for this registration. Common carriers must be approved and licensed by the Public Utilities Commission which is also responsible for their regulation. Reciprocity of contiguous state boat registration is provided for. (Dearing-Florida)
W70-04187

GEORGIA WATER LAW (INTRODUCTION: HYDROLOGIC CYCLE; TERMINOLOGY),
R. C. Kates.
In: Georgia Water Law, Institute of Government, University of Georgia, Athens, Georgia, Chapter 1, p 1-14, 1969.

Descriptors: *Georgia, *Hydrologic cycle, *Hydrologic equation, *Water rights, Hydrologic aspects, Surface waters, Water resources, Legal aspects, Legislation, Judicial decisions, Groundwater, Watercourses (Legal), Rivers, Streams, Lakes, Ponds, Piers, Tidewaters, Navigable waters, Riparian rights, Prior appropriation, Accretion (Legal aspects), Avulsion, Fishing, Ownership of beds.
Identifiers: Definitions.

The increase in industrialization and population has created new and urgent problems of private water use and its public regulation. The last major codification of Georgia water law, which occurred in 1860, was not designed to cope with these problems. The purpose of this book is to examine existing Georgia water law. The content of the private right of water use depends upon the broad relationship between these uses and their resultant effect upon other uses. This relationship is expressed in the hydrologic cycle. This hydrologic equation is used herein to explore the resonableness of Georgia water law. Since they generally accord with the hydrologist's classification of water as it moves through the hydrological cycle, the existing legal categories of classification have been retained. These categories and terms are defined in this introduction and include: (1) surface waters; (2) diffused surface waters; (3) groundwaters; (4) watercourse, stream and river; (5) natural watercourse; (6) tidewaters; and (7) pond and lake. Also introduced are the concepts of: (1) navigability; (2) riparian rights; (3) prior appropriation; (4) accretion and avulsion; (5) wharfage rights; (6) fishery rights; and (7) bed ownership. (See Vol. 2 No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04200

GEORGIA WATER LAW (HISTORICAL BASIS OF GEORGIA RIPARIAN WATER LAW),
R. C. Kates.
In: Georgia Water Law, Institute of Government, University of Georgia, Athens, Georgia, Chapter 2, p 15-23, 1969.

Descriptors: *Georgia, *Riparian rights, *History, *Natural flow doctrin, Relative rights, Obstruction to flow, Diversion, Consumptive use, Judicial decisions, Legislation, Legal aspects, Prior appropriation, Reasonable use, Riparian waters, Alteration of flow, Competing uses, Ownership of beds, Prescriptive rights, Usufructuary right, Water law, Navigable waters.

Georgia follows the modified riparian doctrine. That is, natural flow is subject to reasonable restricted uses. This doctrine emerged in Georgia in the decision of Hendrick v Cook, 4 Ga 241 (1848). It is important to understand various formulations of the riparian rights concept leading to this decision. Early common law attitudes are discussed, including attitudes toward: (1) diversion of water flow by riparian owners; (2) bed ownership; (3) interference with natural flow; (4) fishing rights; (5) prior appropriation; and (6) prescriptive use of nonnavigable stream waters. Early Georgia statutory law is examined as is English and American law immediately prior to 1848. Early law, both statutory and judicial, recognized the natural flow doctrine of riparian rights. However, the doctrine was gradually qualified to prevent the last downstream owners from exercising a virtual monopoly of the consumptive uses of the stream water. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04201

GEORGIA WATER LAW (THE GEORGIA DOCTRINE OF RIPARIAN WATER RIGHTS),
R. C. Kates.
In: Georgia Water Law, Institute of Government, University of Georgia, Athens, Georgia, Chapter 3, p 24-84, 1969.

Descriptors: *Georgia, *Riparian rights, *Reasonable use, *Legislation, Judicial decisions, Relative rights, Obstruction to flow, History, Diversion, Consumptive use, Nonconsumptive use, Water pollution, Riparian land, Riparian waters, Navigable waters, Ownership of beds, Alteration of flow, Usufructuary right, State governments, Legal aspects, Impoundments, Irrigation, Domestic water, Competing uses, New York.

Beginning with the early case of Hendrick v Cook, 4 Ga 241 (1848), this chapter examines the development of the riparian rights doctrine in Georgia. The chapter discusses: (1) the 1860 Georgia codification of riparian law; (2) general considerations of reasonable use; (3) domestic uses; (4) irrigation; (5) the non-approved consumptive uses of detention, obstruction, addition of waters, physical injury to adjoining land and pollution; (6) Georgia's resonable use rule applied to modern impoundments; (7) rejection of the doctrine of balancing the conveniences; (8) protection of quasi-public uses; (9) competing uses by governmental subdivisions; and (10) the present riparian doctrine, its shortcomings, and the feasibility of remedial legislation modeled on the New York example. The proposed statute for Georgia provides; (1) that harmless use is not actionable; (2) for amendment of existing code sections; (3) for ownership of beds; (4) for the right of use of navigable bodies of water whose beds are owned by the state; (5) for a definition of riparian land; (6) for declaratory judgments; and (7) for a remedy for harm to riparian rights caused by interference with subsurface waters. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04202

GEORGIA WATER LAW (WATER POLLUTION IN GEORGIA),
R. C. Kates.
In: Georgia Water Law, Institute of Government, University of Georgia, Athens, Georgia, Chapter 4, p 85-141, 1969.

Descriptors: *Georgia, *Water pollution control, *Pollution abatement, *Water quality control, Legislation, Pollution, Judicial decisions, State governments, Federal goverment, Cities, Industries, Industrial wastes, Coordination, Administrative agencies, Jurisdiction, Public rights, Regulation, Standards, Abatement, Federal jurisdiction, History, Costs, State jurisdiction.
Identifiers: Definitions.

Although compliance with the water purity standards set forth by the Federal Water Pollution Control Act could result in enormous expenditures by industries and municipalities, it is likely that the public will continue to strive for water pollution abatement. The purpose of this chapter is to study both public and private means of such abatement and to interpret recently enacted federal and state statutes and regulations. The chapter discusses: (1) early pollution regulation; (2) the definitions of pollution; (3) the basis of private liability; (4) civil liabilities of municipalities; (5) liability of industry;

(6) reform legislation; (7) exercise of the state's police power; (7) stream classification according to use; (8) quality standards and state enforcement thereof; (9) federal and state enforcement jurisdiction and procedures; (10) public regulation; and (11) private law suits as a deterrent to pollution. Often, judicial and administrative processes work at cross-purposes. What is needed in Georgia is a closer relationship between the courts and the regulating agency so that the powers of each may be effectively combined in the regulation of pollution. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04203

GEORGIA WATER LAW (NAVIGABLE STREAMS, TIDEWATERS),
R. C. Kates.
In: Georgia Water Law, Institute of Government, University of Georgia, Athens, Georgia, Chapter 5, p 142-183, 1969.

Descriptors: *Georgia, *Navigable waters, *Tidewaters, *Relative rights, Ownership of beds, Federal jurisdiction, Federal government, State governments, Interstate compacts, Jurisdiction, Riparian rights, Regulation, Legislation, Legal aspects, Judicial decisions, Non-navigable waters, Navigable streams, Riparian lands, Riparian waters, Recreation, Navigation, Fishing, Watercourses (Legal), State jurisdiction, Federal-state water rights conflicts.
Identifiers: Constitutions, Powers.

Because of the size and number of navigable waterways and tidewaters in Georgia, the law relating thereto is of primary concern as important commercial, navigation, recreational, and fishing interests are determined thereby. Navigable streams, non-navigable tidewaters, and tidewaters are defined, and the chapter discusses: (1) the rights and liabilities of adjacent landowners in non-tidal navigable streams, navigable tidewaters, and non-navigable tidewaters; (2) ownership of beds; (3) 1863 Georgia legislation changing common law rights in navigable streams; (4) federal powers, restrictions and requirements; (5) the impact of federal powers on state water law; (6) the relation of federal law to state police power; and (7) the relation of federal law to individual property rights. Federal powers examined include: (1) the war power; (2) the taxing and general welfare powers; (3) the property clause powers; (4) interstate compact powers, and (5) powers relating to disputes between states. This chapter attempts to delineate the respective authority of federal and state governments in relation to Georgia waters, to explore the constitutional protections given private property from unauthorized governmental taking, and to analyze the rights of riparian owners on navigable streams. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04204

GEORGIA WATER LAW (LAKES AND PONDS),
R. C. Kates.
In: Georgia Water Law, Chapter 6, p 184-209, Institute of Government, University of Georgia, Athens, Georgia, 1969.

Descriptors: *Georgia, *Lakes, *Ponds, *Relative rights, Ownership of beds, Navigable waters, Non-navigable waters, Fishing, Boating, Swimming, Legislation, Judicial decisions, Public rights, Reasonable use, Artificial watercourses, Land tenure, Regulation, Recreation, Recreation demand, Developed waters, Shores, Legal aspects.

The development of artificial or natural lakeside residential areas and the greater pressures of recreational needs in such waters increasingly call for clearer definitions of the legal rights of interested parties, including members of the public. However statutory and case law in Georgia provides little guidance in this area. This chapter examines the existing Georgia law and discusses: (1) title to the beds of artificial, natural, and non-navigable lakes and ponds; (2) rights of owners of beds of lakes and ponds; (3) the right of adjacent owners to reasonably use the surface waters of non-navigable lakes; (4) existing public regulation relating to use of non-navigable lakes; (5) legal theory to support additional regulation relating to use of non-navigable lakes; (6) public rights in lakes and their possible extension; and (7) regulation of fishing, boating, and bathing. The desirability of public development of lakes, ponds, and shoreline is weighed against private development thereof. (See Vol. 2, No. 15, Field 6E, ENTRY W69-06009). (Marsee-Florida)
W70-04205

GEORGIA WATER LAW (DIFFUSED SURFACE WATERS),
R. C. Kates.
In: Georgia Water Law, Chapter 8, p 210-226, Institute of Government, University of Georgia, Athens, Georgia, 1969.

Descriptors: *Georgia, *Surface runoff, *Surface waters, *Relative rights, Drainage, Beneficial use, Judicial decisions, Legislation, Legal aspects, State governments, Obstruction to flow, Repulsion (Legal aspects), Civil law, Riparian rights, Impoundments, Drainage water, Riddance (Legal aspects), Discharge (Water), Prescriptive rights, Diffusion, Evaporation.
Identifiers: Definitions.

Diffused surface waters are distinguished from natural watercourses in that the former have no natural boundaries or permanency and are not part of any defined surface or subterranean stream of water. Their source is precipitation, melting snow or percolation from the ground. They differ from groundwaters in that they are found on the surface of the earth and are temporary in nature, being evaporated or diffused by natural drainage. Most surface water law is concerned with land drainage rights and liabilities between private parties. In Georgia the law of surface waters is the product of judicial decision rather than statute. That decisional law is examined herein within the framework of the opposing common enemy and civil rule theories. The chapter discusses: (1) the general drainage law in Georgia; (2) discharge of surface water by artificial means; (3) case law and statutory law; (4) obstruction of flow and prescription; (5) pollution; (6) beneficial use; and (7) the relation of the right of collection for beneficial use to the law of riparian rights. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04206

GEORGIA WATER LAW (SUBTERRANEAN WATERS, PERCOLATING WATERS SUBTERRANEAN STREAMS, SPRINGS),
R. C. Kates.
In: Georgia Water Law, Chapter 8, p 227-244, Institute of Government, University of Georgia, Athens, Georgia, 1969.

Descriptors: *Georgia, *Underground streams, *Percolating water, *Subsurface waters, Legal aspects, Springs, Legislation, Judicial decisions, Reasonable use, Wells, Well regulation, Hydrologic cycle, Hydrologic equation, Relative rights, Land tenure, Underflow, Underground, Water sources, Regulation, Social change, Groundwater, Water table, Water resources.

Because of the inherent difficulties in demonstrating with legal precision the physical characteristics of underground waters, such waters have been assigned an arbitrary legal classification that disregards the hydrological interrelationship of diffused surface waters, subterranean stream, and natural surface bodies. Georgia cases give little consideration to the lowering of a water table through excessive withdrawals of groundwater. The concept of absolute dominion over underlying groundwaters is a product of social and economic conditions existing when water was plentiful and population pressures few. A change in these factors requires a re-examination of the prior decisional law in Georgia. This chapter discusses Georgia decisional and statutory law as it relates to: (1) absolute ownership, reasonable use and correlative rights in percolating waters; (2) subterranean streams; (3) springs and wells; and (4) regulation of underground waters. The chapter concludes that the existing Georgia law of property rights in underground waters, as well as the public regulation thereof, is inadequate. This is partially caused by the courts' failure to expressly adopt the reasonable use rule. A statute relating to the use of underground waters is proposed for enactment. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04207

GEORGIA WATER LAW (PROCEDURES AND REMEDIES),
R. C. Kates.
In: Georgia Water Law, Chapter 9, p 245-305, Institute of Government, University of Georgia, Athens, Georgia, 1969.

Descriptors: *Georgia, *Legal aspects, *Remedies, *Adjudication procedure, Water quality control, Legislation, Judicial decisions, Regulation, Governments, State governments, Federal government, Administrative agencies, Assessments, Drainage districts, Pollution abatement, Condemnation, Permits, Public rights, Damages, Administration.

As related to Georgia water law, this chapter discusses: (1) state proceedings; (2) parties at interest; (3) pleadings; (4) measure of damages; (5) injunctions; (6) involvement of the public interest; (7) procedure under the Water Quality Control Act; (8) permits; (9) pollution abatement; (10) condemnation proceedings; (11) statutory procedures; (12) remedies; (13) federal condemnation proceedings; (14) special assessments for drainage districts; and (15) formation of agency regulations. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04208

GEORGIA WATER LAW (ADMINISTRATIVE STRUCTURE OF WATER USE AND WATER COURSES REGULATION),
R. C. Kates.
In: Georgia Water Law, Chapter 10, p 306-331, Institute of Government, University of Georgia, Athens, Georgia, 1969.

Descriptors: *Georgia, *Administrative agencies, *Regulation, *Administration, Coordination, Institutions, Organizations, Adjudication procedure, Federal government, Permits, State governments, Administrative costs, Leadership, Interstate commissions, Cities, Drainage districts, Water districts, Water users, Southeast U.S., Atlantic Coastal Plain, Public health, Fishing, Agriculture, Forestry.

Besides the Water Quality Control Board, numerous other non-federal units and agencies in Georgia are empowered to exercise varying degrees of control over water use. Many of these bodies are classified in this chapter according to the level of government at which the particular controls are exercised: (1) agencies functioning interstate; (2) state departments and commissions; (3) special purpose districts; (4) counties, municipalities and other public corporations; and (5) quasi-public corporations. Bodies discussed include: (1) Atlantic States Marine Fisheries Commission; (2) Resources Advisory Board; (3) Commission on Interstate Cooperation; (4) Southeastern Basin Inter-agency Committee; (5) Department of Agriculture; (6) Division of Conservation; (7) Department of Industry and Trade; (8) Department of Public Health; (9) Game and Fish Commission; (10) Forestry Commission; (11) Georgia Recreation Commission; (12) Mineral Leasing Commission; (13) Public Service Commission; (14) Rivers and Harbors Development Commission; (15) Soil and Water Conservation Commit-

tee; (16) drainage districts; (17) soil and water conservation districts; (18) sanitation districts; (19) counties; and (20) municipalities. The chapter also examines recent reorganizational developments in the administrative structure of Georgia water use control, and notes overlaps of authority and duplications of functions. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04209

WATERWAYS AND MILLDAMS.
Ky Rev Stat Ann secs 182.170-182.240 (1963).

Descriptors: *Kentucky, *Condemnation, *Mill dams, *Dams, Legislation, State governments, Dam construction, Administrative agencies, Flood control, Damsites, Regulation, Boundaries (Property), Condemnation value, Cost repayment, Economic impact, Industrial use (Water), Riparian rights, Legal aspects, Canals, Navigation, Fish passages, Public health.

In order to build a mill or factory, a riparian landowner may obtain permission and acquire sufficient land by condemnation to build a dam across any watercourse on which his property is located and whose bed is owned by him or the state. Condemnation proceedings are to be in accordance with this act and brought in the county in which the condemned lands are situated. The appointed condemnation commissioners must report to the county court their findings as to: (1) what ought to be the height of the dam; (2) whether homes or gardens will be overflowed; (3) whether navigation and fish passage will be obstructed; (4) whether health conditions will be impaired; (5) a metes and bounds description of the lands to be taken; (6) what would be just compensation for the lands taken; and (7) whether a mill or factory would be helpful to the public. Permission to construct is within the court's discretion. Servient landowners may construct any structure which will not interfere with permitted water flow. No vested water interests may be violated. Time limitations on building the dam and mill or factory are imposed. (Barnett-Florida)
W70-04220

DESTROYING BRIDGES AND INJURING CANALS.
Va Code Ann secs 18.1-81, 18.1-147 (1960).

Descriptors: *Virginia, *Bridges, *Dams, *Canals, Legislation, Locks, Damages, Burning, Explosives, Explosions, Public utilities, Electric power, Electric wires, Electric switches, Legal aspects, Obstruction to flow.
Identifiers: Penalties (Criminal).

Burning or in any way maliciously destroying any bridge, lock, or dam is made punishable by imprisonment for from one to ten years. It is declared unlawful to maliciously obstruct or damage canals, electric power lines, or bridges. (Schram-Florida)
W70-04222

DREDGING OR SCRAPING FOR OYSTERS.

Va Code Ann secs 28.1-128 thru 28.1-135 (1969).

Descriptors: *Virginia, *Oysters, *Administrative agencies, *Dredging, Legislation, Administrative decisions, Regulation, Commercial shellfish, Shoals, Beds, Ownership of beds, Permits, Boats, Taxes, Tax rate, Legal aspects, Commercial fishing.
Identifiers: *Dredging equipment, *Oyster beds.

It is declared unlawful: (1) to take and catch oysters with dredges and scrapes from any public rocks, beds, or shoals; (2) to have dredging equipment aboard a boat unless a dredging license or permit is available for inspection on the boat; and (3) to allow licensed dredging equipment to be transported on board a boat except in certain instances. The Marine Resources Commission may authorize the use of dredges upon public beds and shoals of Tangier Sound during December, January, and February. The procedures for applying and issuing dredging licenses are detailed. Taking or catching oysters, except with ordinary oyster tongs or by hand, is prohibited and declared a felony. A license tax for dredging is provided. Dredging or scraping for oysters upon private oyster-planting grounds by those licensed for such activities is permitted under stated conditions. This privilege is further conditioned upon properly marking the oyster lines of the planting grounds with fixed buoys. The Marine Resources Commission is authorized to revoke all permits and licenses for one year for violation of these dredging provisions. A hearing is required for such revocation. (Schram-Florida)
W70-04224

OYSTER REGULATIONS.

Va Code Ann secs 28.1-136 thru 28.1-142 (1969).

Descriptors: *Virginia, *Shellfish, *Oysters, *Clams, Legislation, Administrative agencies, Administrative decisions, Commercial fishing, Crabs, Commercial shellfish, Legal aspects, Lime, Measurement, Regulation, Permits, Marine fisheries.

It is illegal to carry away oysters or clams or to take shells or seeds that have been planted for the formation of oyster beds. Anyone found guilty of taking oysters from public grounds shall, without notice or hearing, have any existing licenses to take or catch finfish or shellfish revoked. No new licenses shall be issued to such person for a minimum of one month. Except with the permission of the Marine Resources Commission, it is unlawful to take or catch oysters or shells for the purpose of converting them into lime. Taking or loading shellfish on Sunday nights is prohibited. It is unlawful to sell or distribute oysters or clams as Virginia oysters or clams unless they have been in the waters of Virginia for at least six months. It is unlawful for any boat licensed to catch crabs with a dredge to allow more than one bushel of oysters on board. (Schram-Florida)
W70-04225

FISH, OYSTER, AND SHELL FISH.
Va Code Ann secs 28.1-143 thru 28.1-159 (1969).

Descriptors: *Virginia, *Oysters, *Shellfish, *Administrative agencies, Legislation, Channels, Channel improvement, Dredging, Leases, Beds, Ownership of beds, Navigable streams, Rivers, Shoals, Crabs, Clams, Agriculture, Commercial shellfish, Width, Depth, Length, Boundaries (Property), Surveys.
Identifiers: *Advisory reports.

It is unlawful to use rakes or scrapes to take oysters, crabs, clams, or shells from the beds, rocks, and shoals on the ocean side of Accomack and Northampton counties. The deep water planting grounds of the James and Rappahannock rivers are part of the public oyster beds and may not be leased or assigned by the Commission of Fisheries. Dredging for oysters in the James River is prohibited unless a permit has been granted. After receiving advisory reports from various state agencies, the Governor may authorize the dredging of channels of navigable streams whose beds are owned by the state. Channel improvements in the James River must be approved by the General Assembly. Certain areas are declared to be natural oyster rocks, beds, and shoals and are made unassignable for private use. Detailed descriptions of these areas are included. Certain acts declaring other areas to be natural oyster beds, rocks, and shoals are continued in force. (Schram-Florida)
W70-04226

COUNTY BRIDGES.

Ohio Rev Code Ann secs 5591.01 thru 5591.44 (Page, 1953).

Descriptors: *Ohio, *Bridges, *Bridge construction, *Local governments, Legislation, Legal aspects, Railroads, Bridge design, Administration, Streams, Canals, Boats, Highways, Road construction, Construction, Costs, Tax rate, Easements, Taxes, Cities, Bodies of water.

The board of county commissioners must construct and repair all necessary bridges over streams and public canals in municipal corporations not participating in the bridge fund. They may also issue bonds, which may be submitted to the electorate; acquire all lands and easements necessary; construct and maintain swing or lift bridges; purchase toll bridges; maintain and operate a free ferry; and, may enter into contracts with railroad companies for the joint construction, operation and use of bridges designed to carry railroad and general highway traffic. The board may establish new highways and approaches to bridges and may modify or alter existing bridges, highways and approaches. Authority is granted to these boards to maintain suits for damages to bridges under their control. (Casey-Florida)
W70-04227

SOUTH VENICE CORP V CASPERSEN (OWNERSHIP OF BEDS).
229 So 2d 652-657 (2d DCA Fla 1969).

Descriptors: *Florida, *Ownership of beds, *Boundaries (Property), *Boundary disputes, Nonnavigable waters, Navigable waters, Islands, Swamps, Bulkhead line, Dredging, Beds under water, High water mark, Watercourses (Legal), Legal aspects, Judicial decisions, Riparian rights, Bays.

Defendant corporation applied for a permit to establish a bulkhead line and dredge fill for an area which included an island and a portion of the submerged bottom of Lemon Bay in Sarasota County. Plaintiff Caspersen sought determination that he was the owner of the island and the submerged bottom. Plaintiff had earlier conveyed property 'east of Lemon Bay' to defendants. The trial court held that the portion of Lemon Bay in question was nonnavigable. Therefore, plaintiff was the owner of the submerged beds. The common property line between plaintiff's and defendant's tracts of land was the mean high water line of Lemon Bay adjacent to defendant's uplands. The island in question, being at the mouth of a creek, was in the bay and not in the creek, and therefore was not covered by the conveyance. The appellate court affirmed, holding that the bed of the non-navigable bay was in effect 'swamp and overflowed lands'. As land generally does not pass under a deed as appurtenant to land, the submerged beds did not pass to defendant under the riparian rights included in the original conveyance. The court held that as the bay was non-navigable, plaintiff validly had title to the submerged beds and the proper boundary between defendant's uplands and plaintiff's beds was the mean high water line of the bay. (Caldwell-Florida)
W70-04233

RAFTS AND BOOMS - INCORPORATION OF COMPANIES.
Mo Ann Stat secs 422.010, 422.070, 422.090 thru 422.120, 422.160 thru 422.180, 422.210 thru 422.230 (1952).

Descriptors: *Missouri, *Lumbering, *Water rights, *Lumber, Industries, Water management (Applied), Legislation, Legal aspects, Forest management, Construction materials, Pulp and paper industry, Engineering structures, Navigable waters, Streams, Rivers, River systems, Water utilization.
Identifiers: *Booms.

Any five or more persons associated for the purpose of engaging in and carrying on the business of running, driving, booming and rafting logs, timber, lumber, and other floatables on any Missouri waters or for constuction of booms across or in any such waters, may be incorporated. Every corporation is authorized to construct, use and maintain all

necessary booms for the business of such corporation. Such corporations have the power to carry on the business of driving, booming, rafting and running logs, timber, lumber or other floatables. In conducting the above activities, the corporation has a lien on the logs, timber or other floatables driven, boomed, rafted or run. The corporation is entitled to retain the possession of such logs, timber, lumber or other floatables or so much thereof as may be necessary to satisfy operational charges. Any corporation may break jams of logs, timber or lumber in or upon rivers, creeks, or streams. Specific provisions prescribe a system of marking logs, lumber or other timber. The recovery of drifted timber is regulated. (Powell-Florida)
W70-04235

RECREATION, FISH, WILDLIFE FACILITIES.

Mo Senate Bill No 58, Act 91 (Legis Service No 2, 1969).

Descriptors: *Missouri, *Recreation, *Recreation facilities, *Wildlife, Legislation, Administrative agencies, Administrative decisions, Reservoirs, Federal government, Federal project policy, Cost sharing, Projects, Contracts, Costs, Reservoir management, Wildlife conservation, Reservoir fisheries, Multiple-purpose reservoirs, Reservoir operation, Separable costs, Water policy, Maintenance, Natural resources, Conservation, Water resources development.

The Missouri Federal Water Projects Recreation Fund is created. The General Assembly of Missouri may transfer money from the General Revenue Fund to the Recreation Fund and may appropriate money from the Fund to pay non-federal costs associated with the enhancement of recreation and fish and wildlife benefits on federal reservoir lands and waters as required by the Federal Water Projects Recreation Act. Unexpended balances in the Fund at the end of the appropriation period shall not be transferred to the General Revenue Fund. The Interagency Council for Outdoor Recreation shall make an annual report containing all reports and recommendations submitted to the Council from the responsible state agencies. The Council, with the approval of the pertinent state agency, may enter into agreements to administer federal project land and water areas for recreation or fish and wildlife enhancement in accordance with the Federal Water Projects Recreation Act. The Council may indicate the intent of Missouri to bear not less than one-half of the separable costs of the project allocated to those purposes and to bear all operation, maintenance, and replacement costs. (Schram-Florida)
W70-04239

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME I.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04299

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME III.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04301

NAVIGATION: WATER TRANSPORTATION (BOAT REGISTRATION, COMMON CARRIERS).

NH Rev Stat Ann secs 270:1 thru 270:9 (1966), as amended, (Supp 1967).

Descriptors: *New Hampshire, *Boats, *Permits, *Navigation, Administrative agencies, Taxes, Inspection, Equipment, Buoys, Transportation, Navigable waters, Inland waterways, Tidal waters, Public health, Safety, Assessments, Engineering personnel, Personnel, Government finance, Public utilities, Boating regulations, Boating, Legislation, Rates.
Identifiers: *Registration, *Common carriers, Obstruction to navigation.

Boat dealers may be assigned a general registration certificate and number to be used on all boats and motors kept for sale. Any boat propelled by a gas, gasoline or naphtha engine or motor, except when operated in a licensed boat race, must be equipped with an under-water exhaust or other muffling device. It is unlawful to remove or injure any buoy, beacon or other aid to navigation or to moor any vessel thereto. It is also unlawful to place any obstructions to navigation in the navigable waters of the state. Any prearranged boat race must be approved and licensed by the Director of Safety Services. (Dearing-Florida)
W70-04327

NAVIGATION: WATER TRANSPORTATION (BOAT REGISTRATION AND REGULATION).

N H Rev Stat Ann secs 270:10 thru 270:17-a (1966).

Descriptors: *New Hampshire, *Boats, *Permits, *Boating regulations, Boating, Transportation, Public utilities, Personnel, Administrative agencies, Decision making, Administrative decisions, Legal aspects, Inspection, Equipment, Taxes, Government finance, Training, Accidents, Legislation, State governments, Political aspects, Safety.
Identifiers: *Reports, *Records, Hearings.

The Public Utilities Commission may require common carriers by water to submit annual reports, keep records and exhibit all accounts and records to the Commission. The Director of Safety Services may: (1) make and enforce rules and regulations concerning the personnel, operation, and equipment of any boat in public waters; (2) regulate the maximum horsepower of boat engines or outboard motors, and the speed limits in public waters; and (3) prohibit the use of motor boats on small waterbodies. Certificates granted to commercial boats or their personnel and any boat registration may be revoked and criminal sanctions imposed for violation of this act or any rules or regulations prescribed by the Department of Safety. Power boats owned by non-residents and registered in a contiguous state may be operated in this state without additional registration if the registering state reciprocates. (Dearing-Florida)
W70-04345

MILLER V PRARIE CANAL CO (ACCESS RIGHTS OF OWNER OF CANAL EASEMENTS).

229 So 2d 752-755 (3d Cir La 1969).

Descriptors: *Louisiana, *Canals, *Easements, *Damages, Right-of-way, Access routes, Maintenance, Relative rights, Levees, Conveyance structures, Repairing, Channel improvement, Width, Project purposes, Land use, Non-consumptive use, Reasonable use, Canal embankments, Remedies, Legal aspects, Judicial decisions, Competing uses.
Identifiers: Right of access.

Plaintiff landowner brought action against defendant owner of canal servitude through plaintiff's land for damages to land and fences arising out of an alleged trespass when defendant entered plaintiff's land to clean and maintain the canal and construct new levees. From a verdict for defendant, plaintiff appealed. The court affirmed and held that defendant's ownership of the canal right-of-way implicitly carried with it a right to use the canal for its intended purpose without the consent of the owner, and concluded that the owner of a canal easement had the right to enter plaintiff's property without his consent as a means of access to the canal for the purposes of cleaning, maintenance, and construction. The canal owner had no right to cause unnecessary damage to the plaintiff's land, but as it was not shown that the canal was unnecessarily widened beyond the reserved right-of-way, or that plaintiff suffered unnecessary damage to his land or fences in construction of the new levees, the trial court properly found for defendant. (Caldwell-Florida)
W70-04362

NAVIGATION: WATER TRANSPORTATION (BOAT REGISTRATION AND REGULATION, NAVIGATION).

N H Rev Stat Ann secs 270:18 thru 270:30 (1966).

Descriptors: *New Hampshire, *Boats, *Boating regulations, *Permits, Regulation, Legal aspects, Payment, Recreation, Navigation, Buoys, Safety, Navigable waters, Aircraft, Administrative agencies, Streams, Boating, Water sports, Legislation.
Identifiers: Beacons.

The Director of Safety Services, Department of Safety, shall supplement United States inspection laws by inspecting all commercial and private boats on public waters. The Director shall also supervise navigation safety and navigation aids including all lights and buoys. Registration of all commercial and private boats and all outboard motors is required. Fees are required for such registration, for inspection of commercial vessels, and for the issuance of boat operator's licenses and dealers certificates. Boats operating as common carriers with regular routes and schedules on the public waters must be authorized to do so by the Public Utilities Commission. Application for such authorization will be granted if the need for such service is shown and if the applicant is fit, willing, and able to perform the service and to conform to the applicable rules. Every common carrier by water shall establish, publish and maintain rates for transportation of passengers or property. (Dearing-Florida)
W70-04389

FLOOD PLAIN MANAGEMENT STRATEGY: AN ANALYSIS,
Chicago Univ., Ill. Center for Urban Studies.
For primary bibliographic entry see Field 06B.
W70-04424

BRIDGE CORPORATIONS.

Mo Ann Stat secs 351.035, 351.040 (1963).

Descriptors: *Missouri, *Bridges, *Cities, Legislation, Bridge construction, Streams, Rivers, Land use, Eminent domain, Structures, Contracts, Local governments, Transportation, Mechanical equipment, Roads, Access routes, Damages, Operation and maintenance.

Bridge corporations are authorized to construct and maintain bridges for public use over streams within or bordering the state or within any adjoining state. The construction and operation of toll bridges is authorized. Bridge corporations are given the power to charge reasonable tolls and construct access routes to the bridge. The consent of municipal authorities must be obtained for the construction of such bridge within city limits. The power to make contracts for the use of the corporation's property by lease or otherwise is expressly granted. Such bridge corporation has the power to construct and maintain approaches for said bridge or viaduct in any street or alley of any such incorporated city or town in this state. In effect, this gives the bridge company the power of eminent domain, subject to the consent of the municipality involved. Such consent may not be granted until all damages to abutting property have been ascertained and paid. (Caldwell-Florida)
W70-04427

A RIVER DIES--AND IS BORN AGAIN,
For primary bibliographic entry see Field 05G.

W70-04428

THE REBIRTH OF A RIVER,
For primary bibliographic entry see Field 05G.
W70-04436

ABANDONMENT OF ROADS FOR FLOODING.
Va Code Ann secs 33-82 thru 33-95, 33-97 (1953).

Descriptors: *Virginia, *Highway relocation, *Dams, *Cities, Legislation, Highways, Right-of-way, Road construction, Roads, Flood control, Floodgates, Flooding, Flood damage, Submergence, Spillways, Water works, Water supply, Earth dams, Dam construction, Dam design, Dam failure, Dam foundations, Floodgates, Streams, Obstruction to flow.

State roads flooded by the expansion of a municipal water works system outside its corporate limits may be abandoned only if the city has complied with the procedures provided. Upon approval of the relocation by the county, the city submits relocation plans to the State Highway Commission. Upon approval of the plans by the Commission, the city acquires rights of way and constructs the highway at its own expense. Upon completion, the highway becomes a part of the state highway system. Owners of dams are required to maintain those supporting state highways. The Commission may widen or strengthen dams or bridges to support traffic. If a dam is washed out, the owner may pay a portion of the cost of reconstruction to the Commission. If he refuses, the Commission may reconstruct the highway without the owner's consent. If a dam is partially washed away because of an inadequate spillway, it may not be restored unless the spillway is improved, in part at state cost. Statutes declaring certain streams to be highways are continued in force. (Douberley-Florida)
W70-04482

HIGHWAYS, BRIDGES AND FERRIES.
Va Code Ann secs 33-169 thru 33-171, 33-174 thru 33-178, 33-181, 33-182, 33-191, 33-202, 33-203 (1953).

Descriptors: *Virginia, *Rivers, *Boats, *Transportation, Legislation, Regulation, River regulation, Streams, Highways, Transfer, Eminent domain, Interstate rivers, Navigable rivers.
Identifiers: *Ferries.

A fine is provided for transporting persons or property on a watercourse within one half mile of a lawfully established ferry. The operator of a ferry on a watercourse bounding the state and within two miles of an authorized ferry must pay the lawful operator a sum for each crossing. A person who wishes to establish a ferry must post a public notice and apply to the county or municipal court. Viewers are appointed to determine whether public convenience will result from the proposed ferry. If the watercourse divides two counties or a county and a city, applications must be made to both governmental units. No ferry may be authorized within half a mile of another ferry. A penalty is provided for operating a ferry without the proper authority. When a ferry which transports vehicles as a part of a highway system cannot or is not being operated, the highway commissioner upon approval by the Governor may acquire the ferry and necessary facilities by eminent domain for temporary use by the highway system. (Douberley-Florida)
W70-04490

APPROPRIATION OF PROPERTY.

Ohio Rev Code Ann sec 719.01 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Cities, *Real property, Legislation, Levees, Wharves, Aqueducts, Canals, Ditches, Drains, Sewers, Sewage treatment, Waste treatment, Sewage disposal, Water supply, Appropriation, Reservoir storage, Pumping plants, Water wells.

Any municipal corporation may appropriate, enter and hold real property within its limits for levees, wharves, landings, bridges and aqueducts. Property may also be held for constructing or improving any canal or watercourse not owned by the state or by an individual authorized to make improvements. Other authorized purposes for holding land include sewers, drains, ditches, and sewage disposal plants. To provide for a water supply, a municipality may appropriate property within or without its limits. (Douberley-Florida)
W70-04531

HAUSEY V RONALDSON (BOUNDARY DISPUTES).
228 So 2d 759-763 (1st Cir 1969).

Descriptors: *Louisiana, *Boundary disputes, *Boundaries (Property), Islands, Real property, Legal aspects, Swamps, Bogs, Marshes, Surveys, Bayous, Rivers, Junctions, Boundaries (Surfaces), Streams, Drainage programs, Drainage, Drainage effects, Dredging.
Identifiers: *Natural boundaries.

Plaintiffs sought a declaratory judgment to determine the true ownership of a portion of an island. The plaintiffs' claim to the land was based on record title and possession. The defendants' contention was based on a deed which had conveyed to defendants' predecessor in title 203 acres of land. Defendants asserted that the disputed 29 acres made up the balance of the 203 acres described in their chain of title. In affirming the decision of the trial court, the Court of Appeal of Louisiana held that the natural boundaries described in the plaintiffs' chain of title were superior to defendants' quantity calls. The court ruled that both chains of title contained unclear boundary descriptions but granted judgment to the plaintiffs based upon their chain of title which particularly recited that the property extended to and was bounded by the Comite River on the south. Defendants additionally asserted that by granting title to the disputed land to the plaintiffs, the quantity of acreage described in the plaintiffs' chain of title would be exceeded. The court declared, however, that the natural boundaries described in plaintiffs' chain of title required such a finding. (Schram-Florida)
W70-04534

WATERCRAFT REGULATION.
For primary bibliographic entry see Field 05G.
W70-04535

6F. Nonstructural Alternatives

FLOOD-HAZARD MAPPING IN METROPOLITAN CHICAGO,
For primary bibliographic entry see Field 04A.
W70-04170

THE ECONOMICS OF NATURAL DISASTERS: IMPLICATIONS FOR FEDERAL POLICY,
For primary bibliographic entry see Field 06B.
W70-04172

THE NEED FOR COMPREHENSIVE DISASTER INSURANCE,
For primary bibliographic entry see Field 06B.
W70-04181

WISE USE OF FLOOD PLAINS (STATE FLOOD CONTROL REGULATION).
For primary bibliographic entry see Field 04A.
W70-04215

WISE USE OF FLOOD PLAINS (RECOMMENDATIONS FOR WISE FLOOD PLAIN MANAGEMENT).
For primary bibliographic entry see Field 04A.
W70-04217

EFFLUENTS AND AFFLUENCE,
New England Interstate Water Pollution Control Compact.
For primary bibliographic entry see Field 05G.
W70-04429

6G. Ecologic Impact of Water Development

WATER QUALITY MANAGEMENT, FIRST ANNUAL REPORT FOR PERIOD ENDING JUNE 30, 1969.
Miami Conservancy District, Dayton, Ohio.
For primary bibliographic entry see Field 05G.
W70-04096

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME I.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04299

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME III.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04301

EFFECTS OF WEATHER MODIFICATION ON PLANT AND ANIMAL COMMUNITIES,
Michigan Univ., Ann Arbor. School of Natural Resources.
For primary bibliographic entry see Field 02B.
W70-04391

ECOSYSTEM SCIENCE AS A POINT OF SYNTHESIS,
S. Dillion Ripley, and Helmut K. Buechner.
Daedalus, Vol 96, No 4, p 1192-1199, Fall 1967. 2 ref.

Descriptors: *Ecosystems, *Methodology, *Planning, Ecology, Environment.
Identifiers: Levels of integration, Points of view.

A two-dimensional conceptual model is presented, based on levels of integration and points of view, as an aid in orienting knowledge with relevance to the ecological crisis. The first dimension of the model considers levels of biological integration in terms of ecosystems. Biological entities, such as cells, organisms, populations, and communities, represent levels of integration in which the whole is more than a mere sum of the parts. Any of these levels of integration can be considered an ecosystem if the total environment is added as an integral part of the system. The societies of man, together with their total environment, form the highest level of biological integration. Man's societies dominate all ecosystems on earth. Accordingly, we need to concentrate our orientation of knowledge on the human-society-plus-environment level of integration because of its relevance to the central world problem of achieving a reasonably steady state between human societies and the finite resources of our planet. The second dimension of the conceptual model concerns points of view. Any entity may be studied from the following points of view: (1) the components of the system; (2) structure or morphology; (3) functions and processes; (4) distribution in time; (5) distribution in space; (6) relationships to environment; and (7) classification. These are related to the human-society-plus-environment level of integration. (Davis-Chicago)
W70-04433

07. RESOURCES DATA

7A. Network Design

REDEFINITION OF SALINITY,
Scientific Committee on Oceanic Research (Gt. Brit.); International Council for the Exploration of the Seas; and International Association for the Physical Sciences of the Ocean.
Warren S. Wooster, Arthur J. Lee, and Gunter Dietrich.
Journal of Marine Research, Vol 27, No 3, p 358-360, Sept 15, 1969. 3 p, 6 ref.

Descriptors: *Sea water, *Salinity, *Analytical techniques, *Conductivity, *Water analysis, Water properties, Water chemistry, Electrolytes.
Identifiers: Salinity determination, Chlorinity.

With the development of precise methods for measuring the electrical conductivity of seawater, it has become possible to consider a new definition of salinity based on conductivity. In October 1966, International Oceanographic Tables (UNESCO 1966) were published jointly by UNESCO and the National Institute of Oceanography in Great Britain. These Tables contain a new definition of salinity. In October 1967, the Tables, the definition of salinity, and the stated relationship between salinity and chlorinity were endorsed by IAPSO, which recommended that they be used by oceanographers and that all future oceanographic data reports include an explicit statement of the particular tables used in determining the values of the salinity reported. The conductivity method is now widely used in determining salinity, and the redefinition of salinity is required for its use. (Knapp-USGS)
W70-04318

MEASUREMENT OF ATMOSPHERIC PRESSURE AND SUBSURFACE-GAS PRESSURE IN THE UNSATURATED ZONE OF THE BANDELIER TUFF, LOS ALAMOS, NEW MEXICO,
Geological Survey, Santa Fe, N. Mex.
For primary bibliographic entry see Field 02G.
W70-04335

7B. Data Acquisition

SOIL MOISTURE - INSTRUMENTATION, MEASUREMENT AND GENERAL PRINCIPLES OF NETWORK DESIGN,
Guelph Univ. (Ontario). Dept. of Soil Science.
For primary bibliographic entry see Field 02G.
W70-04115

A DEVICE FOR DETERMINING SEDIMENTATION RATES IN RESERVOIRS,
Bureau of Sport Fisheries and Wildlife, Yankton, S. Dak. North Central Reservoir Investigations.
For primary bibliographic entry see Field 02J.
W70-04191

NEW METHODS OF PROBABILITY CALCULATIONS FOR DISCHARGES AND NON-SCOURING VELOCITIES IN RIVERS' CROSS-SECTIONS,
Institute of Building Technics, Warsaw (Poland).
For primary bibliographic entry see Field 02J.
W70-04255

INFLUENCE OF METHOD FOR REMOVAL OF SESTON ON THE DISSOLVED ORGANIC MATTER,
Washington Univ., St. Louis, Mo. Dept. of Botany.
Bruce C. Parker.
Journal of Phycology, Vol 3, No 4, p 166-173, 1967. 2 tab 20 ref.

Descriptors: *Analytical techniques, *Organic matter, *Seston, Water chemistry, Chemical analysis, Plankton, Filtration, Centrifugation, Dialysis, Scenedesmus, Adsorption, Activated carbon, Missouri, Eutrophication, Lakes, Water pollution effects, Dinoflagellates, Diatoms, Vitamin B, Phytoplankton.
Identifiers: *Organic solutes, Microcystis aeruginosa, Millipore filtration, Continuous-flow centrifugation, Biodialysis, Membrane filters, Scenedesmus quadricauda, Protosiphon botryoides, Paramecium bursaria, Westchester Lake (Mo), Beckman Infrared Carbon Analyzer, Ceratium, Peridinium, Synedra, Fragillaria, Coelastrum, Ankistrodesmus, Trachelomonas, Selas silver membranes, Whatman glassfiber filters, Vitamin B-12, Gelman Metricel filters.

Study of organic solutes in natural waters necessitates removal of seston (particulate organisms and detritus). Usual methods of sample treatment, including filtration and centrifugation, influence composition of water samples, but such problems are little studied and techniques are not standardized. Described are studies of some combinations of sample treatment and storage for laboratory cultures and naturally occurring samples which compare total dissolved carbon remaining after removal of seston. Results indicate that cellulose ester filters contain elutable carbon, removable with prewashing. Filtration to dryness may injure cells and release carbon to filtrates. Significant differences in retention exist between filters with pore sizes of 0.22 and 0.45 microns. Although both have limitations, most satisfactory methods were: wet filtration through prewashed Millipore filters (0.22 microns), and continuous flow centrifugation at 10,000-fold gravity and flow rate of 100 milliliters/minute. Ordinary centrifugation fails to remove some buoyant cells and may cause others to leak carbon. Evidence suggests that newly developed biodialysis technique may be more satisfactory than pre-existing methods. In this technique, a chamber, containing sterile distilled water retained between membrane filters, is placed in situ; dialysis of organic solutes from ambient water into chamber proceeds to equilibrium, while seston is excluded. (Eichhorn-Wisconsin)
W70-04285

ROTARY FLOW METER AS TURBULENCE TRANSDUCER,
Geological Survey, Fort Collins, Colo.
Erich J. Plate, and James P. Bennett.
ASCE Proceedings, Journal Engineering Mechanics Division, Vol 95, No EM6, Paper 6955, p 1307-1329, Dec 1969. 23 p, 10 fig, 13 ref, append.

Descriptors: *Flowmeters, *Turbulence, Instrumentation, Calibrations, Turbulent flow, Mathematical studies, Flow measurement, Gages, Stream gages.
Identifiers: Turbulence meters, Turbulence transducers.

Two factors prevent the direct determination of the point spectrum of axial turbulence from a spectrum of the fluctuations in rpm values of the analog output of a rotary flow meter. The first of these is the effect of the finite size of the flow meter propeller, the second is the effect of its inertia. The finite size effect depends on the local turbulence structure and is characterized by an 'efficiency factor' which in general can only be estimated. The effect of propeller inertia can be evaluated by linearizing the equation of motion of the propeller. From the resulting linear ordinary differential equation with constant coefficients, a transfer function for the linear system can be calculated. This transfer function makes it possible to calculate a spectrum of axial turbulence in which the velocity is averaged over the area of the propeller. Experiments in which propellers were oscillated sinusoidally while being towed through still water showed that the amplitude response function is approximately equal to that of a first-order system, while the phase function appeared to be independent of the natural frequency of the system. (Knapp-USGS)
W70-04308

DESCRIPTION OF A FREELY DROPPED INSTRUMENT FOR MEASURING CURRENT VELOCITY,
Nova Univ., Fort Lauderdale, Fla. Physical Oceanographic Lab.
William S. Richardson, Allan R. Carr, and Henry J. White.
Supported by Office of Naval Research. Journal of Marine Research, Vol 27, No 1, p 153-157, Jan 15, 1969. 5 p, 2 fig, 2 ref.

Descriptors: *Current meters, *Oceanography, *Currents (Water), *Ocean currents, Instrumentation, Flow measurement, Velocity, Drift bottles, Drifting (Aquatic).
Identifiers: Ocean current measurement.

A new form of freely dropped instrument for current-velocity measurements is described. Operational procedures for using the instrument and its auxiliary equipment are given. The instrument is dropped, a fix is taken, and the clock begins to count when the radio signal is lost as the transmitting antenna goes under water. When the instrument returns to the surface, the transmitter comes back on the air. The receiver hears this signal and turns off the clock, which then displays the run time. Since several simultaneous drops to different depths are often made and since each drop requires a back extrapolation from fix position to surfacing position, using the surface drift, a float is used to measure the surface current after the last instrument is dropped. The float has nearly the same dimensions as the instrument, but it is made to float like the instrument on the surface. (Knapp-USGS)
W70-04310

RESPONSE OF GAS-PURGED MANOMETERS TO WATER-LEVEL SURGES,
Geological Survey, Menlo Park, Calif.
J. R. Beck, and C. R. Goodwin.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D274-D277, 1969. 4 p, 3 fig.

Descriptors: *Water level fluctuations, *Steam gages, *Calibrations, *Manometers, Instrumentation, Water levels, Equipment, Laboratory tests, Waves (Water).
Identifiers: Gas-purged manometers, Bubble gages.

Tests were conducted to evaluate the performance of bubble-gage servocontrolled manometers when operating in a lake or stream whose water level is oscillating at amplitudes and frequencies that are likely to be found at medium or high stages in streams or in larger bodies of water subject to wind action. Results of the tests indicate that gas-purged manometers produce an accurate record of water stage under static conditions but indicate a stage value less than the mean of the surge when surface waves of significant amplitudes and frequencies are present. (Knapp-USGS)
W70-04337

DIFFUSION FROM A GASEOUS SOURCE IN A POROUS MEDIUM - A FIELD AND THEORETICAL COMPARISON,
Geological Survey, Idaho Falls, Idaho.
For primary bibliographic entry see Field 02F.
W70-04338

ANALOG COMPUTER MODELS FOR MOVEMENT OF NUCLIDES THROUGH ECOSYSTEMS,
Oak Ridge National Lab., Tenn. Health Physics Div.
For primary bibliographic entry see Field 05B.
W70-04380

ANALYTICAL CHEMISTRY OF PLANT NUTRIENTS,
Wisconsin Univ., Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 05A.
W70-04382

APPLICATION OF A COMPUTER MODEL TO A DESERT WATERSHED,
Arizona Univ., Tucson. Dept. of Watershed Management.
For primary bibliographic entry see Field 02A.
W70-04397

7C. Evaluation, Processing and Publication

ELECTROMODELLING AS AN EFFECTIVE METHOD OF PROGNOSTICATING RESOURCES OF UNDERGROUND WATER DURING THEIR REPLENISHMENT,
U. S. Boot, U. I. Ljalko, and A. A. Falovsky.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (Mar 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 17-22, 1967. 6 p.

Descriptors: *Analog models, *Artificial recharge, *Alluvium, Streamflow, Groundwater movement, Discharge (Water), Resistance networks, Water yield, Infiltration, Groundwater basins.
Identifiers: *Severny Donetsk Valley (USSR).

Artificial and natural recharge of groundwater is predicted by an electric analog model of the Severny Donetsk Valley, USSR. Field hydrogeologic data and measured withdrawals are modeled and the results are used to optimize recharge programs. The model is constructed of electroconductive paper and copper wire. The aquifer modeled is an alluvial valley fill to be recharged with flood waters of the river. (Knapp-USGS)
W70-04128

COMPUTER MODEL OF CONNECTICUT RIVER POLLUTION,
United Aircraft Corp., East Hartford, Conn. Research Labs.
For primary bibliographic entry see Field 05B.
W70-04302

GROUNDWATER FLOW SIMULATED ON COMPUTER AIDS NUCLEAR PLANT RADIOACTIVE WASTE STUDY,
Battelle-Northwest, Richland, Wash. Water Resources Systems Section.
For primary bibliographic entry see Field 05B.
W70-04309

FLOOD OF AUGUST 1969, RICHMOND QUADRANGLE, RICHMOND, VIRGINIA,
Geological Survey, Washington, D.C.
E. M. Miller.
Available from U S Geological Survey, Washington, DC, 20240, for $0.75 per copy. Geological Survey Hydrologic Investigations Atlas HA-410, 1 sheet, 1969. Text, 2 fig, 2 photo, 1 map, 1 tab.

Descriptors: *Floods, *Virginia, *Hurricanes, *Historic flood, Cloudbursts, Peak discharge, Rain, Rain water, River flow, Storm runoff, Stage-discharge relations.
Identifiers: James River (Va), Richmond (Va).

The approximate areas inundated in and near Richmond, Va., by the flood of August 22, 1969, on the James River are shown on a topographic map. The flood was caused by torrential rains brought by the remnants of Hurricane Camille. The flood of May 1771 is considered the greatest in the James River basin since the settlement of Jamestown in 1607. The August 1969 flood at the Virginia Division of Water Resources gaging station, 0.1 mile upstream from the Huguenot Memorial Bridge (river mile 111.7), reached a stage of 24.95 feet, gage datum, (discharge, 222,000-cfs) and was the highest for the period of record (1935-69). At the U.S. Weather Bureau gaging station at river mile 103.7, the flood reached a stage of 28.6 feet, msl, (29.9 ft at former site of U.S. Weather Bureau gaging station at river mile 104.6), and was the highest since the great flood of 1771. (Knapp-USGS)
W70-04348

FLOOD OF AUGUST 1969 ON MAURY RIVER AT BUENA VISTA, VIRGINIA,
Geological Survey, Washington, D.C.
Gerald S. Runner.
Available from U S Geological Survey, Washington, DC, 20240, for $0.50 per copy. Geological Survey Hydrologic Investigations Atlas HA-412, 1 sheet, 1969. Text, 2 fig, 3 photo.

Descriptors: *Floods, *Virginia, *Hurricanes, *Historic flood, Cloudbursts, Peak discharge, Rain, Rain water, River flow, Storm runoff, Stage-discharge relations.
Identifiers: Maury River (Va), Buena Vista (Va).

The approximate area inundated by the Maury River at Buena Vista, Va., during the flood of August 20, 1969, is shown on a photomosaic base map and photographs. The flood, the highest known on the river, was caused by the torrential rains brought by the remnants of Hurricane Camille. Floodmarks were identified in a 4-mile reach of the river near Buena Vista, and their elevations were determined by leveling to bench marks. Flood boundaries were delineated on aerial photographs taken after the crest and were verified by field inspection. The flood of August 20, 1969, reached an elevation of 852.0 ft above mean sea level (msl) at U.S. Highway 60 at Buena Vista and was the highest since records began in 1936 and probably the highest since 1870. The previous maximum of record was 845.8 ft, msl, at the same site during the flood of March 17-19, 1936. Stage-frequency relations were derived from stage records for the U.S. Weather Bureau gage at U.S. Highway 60 at Buena Vista for the period 1936-69. Profiles of the water surface constructed from high-water marks left by the flood are given. (Knapp-USGS)
W70-04349

FLOOD OF AUGUST 1969, DREWRYS BLUFF QUADRANGLE, RICHMOND, VIRGINIA,
Geological Survey, Washington, D.C.
E. M. Miller.
Available from US Geological Survey, Washington, DC, 20240, for $0.75 per copy. Geological Survey Hydrologic Investigations Atlas HA-411, 1 sheet, 1969. Text, 2 fig, 1 photo, 1 map, 1 tab.

Descriptors: *Floods, *Virginia, *Hurricanes, *Historic flood, Cloudbursts, Peak discharge, Rain, Rain water, River flow, Storm runoff, Stage-discharge relations.
Identifiers: James River (Va), Richmond (Va), Flood frequencies.

The approximate areas inundated in and near Richmond, Va., by the flood of August 22, 1969, on the James River are shown on a topographic map. The flood was caused by torrential rains brought by the remnants of Hurricane Camille. The flood of May 1771 is considered the greatest in the James River basin since the settlement of Jamestown in 1607. The August 1969 flood at the Virginia Division of Water Resources gaging station, 0.1 mile upstream from the Huguenot Memorial Bridge (river mile 111.7), reached a stage of 24.95 feet, gage datum, (discharge, 222,000 cfs) and was the highest for the period of record (1935-69). At the U.S. Weather Bureau gaging station at river mile 103.7, the flood reached a stage of 28.6 feet, msl, (29.9 ft at former site of U.S. Weather Bureau gaging station at river mile 104.6), and was the highest since the great flood of 1771. The relationship between recurrence interval and elevation above mean sea level at the gaging station on the James River near Richmond (river mile 111.7) is shown graphically. (Knapp-USGS)
W70-04350

08. ENGINEERING WORKS

8A. Structures

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN ARIZONA.
Corps of Engineers, San Francisco, Calif. South Pacific Div.
For primary bibliographic entry see Field 04A.
W70-04387

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN CALIFORNIA.
Corps of Engineers, San Francisco, Calif. South Pacific Div.
For primary bibliographic entry see Field 04A.
W70-04388

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN UTAH.
Corps of Engineers, San Francisco, Calif. South Pacific Div.
For primary bibliographic entry see Field 04A.
W70-04393

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN NEVADA.
Corps of Engineers, San Francisco, Calif. South Pacific Div.
For primary bibliographic entry see Field 04A.
W70-04394

'ONE HUNDRED AND TWENTY-THREE FEET LONG': THE HORIZONTAL WELL AS A NEW METHOD OF RANGE WATER DEVELOPMENT,
Arizona Univ., Tucson. Cooperative Extension Service.
For primary bibliographic entry see Field 04B.
W70-04396

A WORLD GEOGRAPHY OF IRRIGATION,
For primary bibliographic entry see Field 03F.
W70-04404

CHICAGO'S SOUTH DISTRICT FILTRATION PLANT.
Department of Water and Sewers, Chicago, Ill.
For primary bibliographic entry see Field 05F.
W70-04437

THE CHICAGO SEWER SYSTEM, 100 YEARS OF PROTECTING CHICAGO'S HEALTH,
Department of Water and Sewers, Chicago, Ill.
T. S. Ford, and James Moorman.
Chicago, City of Chicago Department of Water and Sewers, 1956. 22 p, 1 fig, 44 photos.

Descriptors: *Sewers, *Drainage systems, *Sewage, *Storm drains, *Closed conduits, *Channels, *History, Public health, Drainage water, Pipes, Construction, Tunneling, Canals construction, Waste water treatment, Pumping plants, Diseases.
Identifiers: *Chicago, *Chicago Department of Water and Sewers, *Chicago Sanitary District, Interceptor sewers, Sewer construction, Sewer history, Chicago sewer system.

This historical work summarizes the first 100 years of Chicago's city sewer system. A plan for a sewer system was adopted by the Board of Sewerage Commissioners in 1855. The sewers were designed to discharge into Lake Michigan and the Chicago

River. The 'combined' sewers were to be constructed of brick masonry and tile pipe. During 1856, sewers in the present 'Loop' district were built. By 1861, the system included 54 miles of sewers with 2,400 house connections. By 1886, the Chicago River had become a putrid septic tank from sewage discharges, and epidemics were prevalent. The state legislature passed an enabling act and, in 1889, the Sanitary District of Chicago was formed to dig a canal to flush Chicago's sewage to the Mississippi River, via the Fox and Illinois Rivers. The Sanitary and Ship Canal, was completed in 1900. In 1910, the North Shore Channel was completed, and intercepting sewers and two pumping stations were built near the Lake. The Calumet Sag Canal was completed in 1923. Sewage treatment plant construction was begun in 1922. By 1956, Chicago's sewer system included in 3,600 miles of sewers with 450,000 connections, 132,000 manholes and 190,000 catch basins. Its replacement cost was valued at $500 million. (Poertner-Chicago)
W70-04438

CHAPTER 2: DESCRIPTION.
Department of Public Works, Chicago, Ill.
For primary bibliographic entry see Field 04C.
W70-04440

CHAPTER 4: CONSTRUCTION.
Department of Public Works, Chicago, Ill.
For primary bibliographic entry see Field 04C.
W70-04441

8B. Hydraulics

STABILIZATION OF ALLUVIAL CHANNELS,
Colorado State Univ., Fort Collins. Natural Resources Center.
N. G. Bhowmik, and D. B. Simons.
Available from the Clearinghouse as PB-189 768, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 50 p. OWRR Project A-002-COLO.

Descriptors: *Channel stabilization, *Design hydraulic, Alluvial, Bends, Boundary shear, Mechanics, Riprap, Stability, Waves.

Flow dynamics and the effects of turbulent fluctuations of velocity, drag forces, lift forces, waves and secondary circulations on the stability of riprap particles forming the perimeter of stable alluvial channels were studied. A field study was made of three channels successfully stabilized with gravel riprap. Additional available existing data on initiation of motion and on stable channels formed in coarse materials were gathered and analyzed to explain the flow dynamics and to outline a design procedure for canal stabilization. Necessary relationships were developed to facilitate the design of stable channels formed in coarse alluvial materials. A design procedure valid for both the straight reaches and the bends to stabilize alluvial channels is presented.
W70-04050

BOUNDARY EFFECTS ON JET FLOW PATTERNS RELATED TO WATER QUALITY AND POLLUTION PROBLEMS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
W. Hall C. Maxwell, and Hormoz Pazwash.
Available from the Clearinghouse as PB-189 787, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Illinois Water Resources Center, Research Report No 28, Jan 1970. 84 p, 3 tab, 28 fig, 20 ref. OWRR Project B-017-ILL.

Descriptors: *Boundaries (Surfaces), *Diffusion, Flow characteristics, *Flow profiles, *Free surfaces, Hydraulics, *Jets, Temperature, Tracers.
Identifiers: Fluid flow, Free turbulence, Heat flux, Mass flux, Momentum flux, Similarities.

An experimental and analytical study of the modification of jet flow patterns by a nearby free surface and nearby horizontal or gently downward sloping plane bed is described. The patterns were found to be radically different from those for a deeply submerged jet. Both the free surface and bed tend to attract the jet and both cause spreading of the flow in their proximity. One boundary generally proves to be dominant, depending upon the geometrical parameters. The analytic study used Reichardt's hypothesis and its generalization for momentum, mass and heat flux by Alexander, Baron and Comings. The techniques are first applied to predict the effect of finite nozzle size on deeply submerged jet flows. Then the effect of the free surface on a shallow submerged jet is studied. A strong influence by a small initial upward deflection of the jet is indicated. A preliminary suggestion is made for a mathematical model to represent a shallow submerged jet in a shallow reservoir. The results may be applied in the study or design of discharge outlets, syphon spillways, hydraulic breakwaters and diffusion of tracers in streams. The diffusion of momentum, mass or heat may be studied using the analytic techniques.
W70-04068

HYDRAULIC RESISTANCE IN ALLUVIAL CHANNELS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-04070

THE MECHANICS OF A DROP AFTER STRIKING A STAGNANT WATER LAYER,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Harry G. Wenzel, Jr., and Raymond C. T. Wang.
Available from the Clearinghouse as PB-189 790, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Illinois Water Resources Center, Research Report No 30, Jan 1970. 130 p, 3 tab, 4 fig, 147 ref, 4 append. OWRR Project B-018-ILL.

Descriptors: *Impact (Rainfall), *Numerical analysis, *Raindrops, Shear stress, *Sheet flow, Soil erosion, Resistance.

A first step is represented in the theoretical analysis of sheet flow with rainfall impinging on the free surface. This is a common occurrance in urban areas and many design procedures do not recognize the added resistance due to the rainfall. The analytical approach consists of the numerical solution of the Navier-Stokes equations, including surface tension as a boundary condition, using a Synthetic-Cell-Fluid scheme which rigorously conserves mass and momentum. The results include a maximum impact pressure model and a quantitative discussion of pressure distribution, boundary shear, the effect of surface tension, the free surface configuration, and the various forms of energy and its transformation during the impact process. Experiments were performed consisting of drop impact pressure measurements using various drop sizes, impact velocities and water layer depths. These data were used to successfully verify the theoretical work.
W70-04071

MODEL AND PROTOTYPE TESTS OF BUOYANT SPILLWAY GATES,
Pacific Gas and Electric Co., San Francisco, Calif.
Arthur G. Strassburger, and James F. Sias.
Proc Amer Soc Civ Eng, J Power Div, Vol 95, No PO2, p 335-349, Oct 1969. 15 p, 17 fig.

Descriptors: *Radial gates, *Spillway gates, Hydraulic gates, Models, *Model tests, *Prototype tests, Earth dams, Buoyancy, Floods, Floats, Hydraulic models, Water levels, Safety, Reservoir operation, Leakage, Design criteria Spillways, Gate control, Gate seals, Gate seats.
Identifiers: *Test results, McCloud Dam (Calif).

Design of a radial gate, modified to obtain an opening torque, and having an additional upstream projection to obtain buoyancy for fail-safe operation, is presented. Operating requirements for a full reservoir during winter storm periods precluded an uncontrolled spillway or gates held open. An earth and rockfill dam, on the contrary, required fail-safe spillway control. A difficult site added to the design and cost problems. The gate as designed can open to pass in excess of the record flood without external power source or without float wells, tripping devices, counterweights, or other accessories. Model tests were conducted for determining downpull effects of flow under a gate and through adjacent gates. Prototype tests under operating conditions were conducted; results are compared with model test results. Adjustable side plates replace conventional seals to eliminate seal friction and keep leakage to a tolerable limit.
W70-04264

MECHANICS OF FLOW IN OPEN CHANNEL SYSTEMS,
California Univ., Davis. Dept. of Water Science and Engineering.
J. Amorocho, and Alan Babb.
Available from the Clearinghouse as PB-189 954, $3.00 in paper copy, $0.65 in microfiche. California University Water Science and Engineering Paper No 1040, Nov 1969. 10 p, 7 ref. OWRR Grant No B-037-CAL. Grant W113 Univ of Calif.

Descriptors: *Open channel flow, *Hydraulics, *Junctions, *Radial gates, Hydraulic transients, Roughness (Hydraulic), Hydraulic similitude, Model studies, Hydraulic models, Channel morphology, Hydraulic structures, Gates.
Identifiers: Channel transitions, Hydraulic transitions.

Flow phenomena in channel transitions and flow in the neighborhood of open channel gates and controls were studied in laboratory channels. Data were obtained on the variation of the energy losses for warped expansions at high Reynolds' numbers and criteria were established for corrections of incomplete similitude in model investigations of these configurations. Detailed analyses of the fluid mechanics of expansions were advanced with the study of conical shapes. These investigations involved the development of special laboratory techniques and the evaluation of the terms of the integrated equations of energy and momentum balance for the flow in the expanding fields. The analysis of the results will lead to analytic methods for optimum transition design. The behavior of radial gates under a large variety of flow conditions was investigated with particular reference to multigated structures. (Knapp-USGS)
W70-04296

ROTARY FLOW METER AS TURBULENCE TRANSDUCER,
Geological Survey, Fort Collins, Colo.
For primary bibliographic entry see Field 07B.
W70-04308

THE INTERACTION OF INTERNAL WAVES WITH AN UNSTEADY NON-UNIFORM CURRENT,
Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics.
For primary bibliographic entry see Field 02E.
W70-04326

SIMILAR SOLUTIONS OF TURBULENT BOUNDARY LAYER HEAT AND MASS TRANSFER PROBLEMS,
Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Chemical Engineering.
L. F. Donovan, O. T. Hanna, and S. Yerazunis.
Chemical Engineering Science, 1967, Vol. 22, p. 595-610, Pergamon Press.

Descriptors: *Heat, *Heat transfer, *Temperature, Mass transfer, *Turbulent boundary layers, Momentum equation, Turbulence, Thermodynamic behavior, Heat Balance, Shear, Viscosity, Eddies.

It is shown that similar solutions of certain turbulent boundary layer heat and mass transfer problems can be obtained when the thermal and diffusion layers lie within the constant shear layer, as is the case when Prandtl and Schmidt numbers are large. Closed form solutions are obtained for the problems of heat transfer from an isothermal surface, mass transfer with a finite interfacial velocity, and heat transfer from a surface having a particular temperature distribution. A comparison of experimental duct heat transfer data with Spalding function calculated with each of Spalding's laws of the wall shows that one of the laws is significantly superior to the other. (Novotny-Vanderbilt)
W70-04472

TRANSPIRATIONAL HEAT TRANSFER FROM A CYLINDER IN CROSS FLOW INCLUDING THE EFFECTS OF TURBULENT INTENSITY,
Oregon State Univ., Corvallis.
Eugene Elzy, and C. E. Wicks.
Heat transfer-Seattle, Chemical Engineering Progress, Symposium series, Vol. 64, No. 82, 1968, p 150-165.

Descriptors: *Heat transfer, *Reynolds number, *Turbulent flow, Cooling, Mass transfer, Momentum transfer, Boundary layer, Transpiration, Laminar flow, Air, Heat exchangers, Friction, Winds.
Identifiers: *Heat transfer coefficient, Wind tunnel, Air injection.

The local heat transfer coefficient is measured in the laminar and separated regions of a cylinder in cross-flow mounted in a subsonic wind tunnel. Experiments are conducted by uniformly injecting hot air from the porous cylindrical surface. The effects of Reynolds number and turbulent intensity of the mainstream air is studied at various injection rates. The local heat transfer coefficient is decreased by injection in all regions around the cylinder at both low and high turbulent intensities. The experimental results for low turbulence are compared with theoretical predictions by the Eckert and Merk similar methods for the laminar region, and good agreement is obtained. (Novotny-Vanderbilt)
W70-04477

FORCE ON A SMALL SPHERICAL EVAPORATING PARTICLE IN ITS PURE VAPOUR DUE TO MOTION AND TEMPERATURE GRADIENTS,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
G. C. Gardner.
Chemical Engineering Science, Vol. 23, p. 29-40, 1968. 2 fig., 16 ref.

Descriptors: *Evaporation, *Energy transfer, Viscosity, Stress, Temperature, *Velocity, *Temperature distribution, Reynolds number, Equilibrium, Latent heat, Vapor pressure.
Identifiers: *Slip.

Analyses are made for the free molecular regime, where the particle is small compared to the mean free path of vapor molecules, and for the viscous continuum-slip regime, where the particle is large compared to the mean free path. Energy exchange between the vapor and the particle is considered in the free molecular regime as well as the momentum exchange, which has previously been considered for inert, non-evaporating particles. Thus, it is shown that conduction of heat within the particle can have a small importance for the larger particles that are included within the regime. Otherwise the equations for the force on a particle reduce to particular forms of those already derived for inert particles. The equations for the continuum regime, without slip, show that the particle has an equilibrium velocity equal to the velocity that the continuum would attain, if the heat being conducted far from the particle, due to the temperature gradient, was used to evaporate more vapor and thus create a vapor flow. When, however, the particle size becomes small enough for slip to be important, the equilibrium velocity rises above this value. (Novotny-Vanderbilt)
W70-04480

SURFACE RESISTANCE IN TRANSPORT FROM VAPOR TO LIQUID,
Lehigh Univ., Bethlehem, Pa. Whitaker Lab.
Robert W. Coughlin.
Chemical Engineering Science, Vol. 22, p. 1503-1511, 1967. 3 fig., 19 ref.

Descriptors: *Condensation, *Diffusion, Eddies, Jets, *Distribution, Mass transfer, Thermal conductivity, Thermodynamic behavior, Temperature.

The role of surface resistance in the formulation of the penetration theory of interphase transfer is examined for the cases of constant, uniform surface renewal rate and random surface renewal; using the distribution function proposed by Danckwerts, it is shown that both cases are almost equivalent. Some recent data obtained in experiments aimed at measuring the condensation coefficient of water are examined in light of penetration theory formulated with and without surface resistance. It is shown that the data suggest a transition from the conventional penetration theory (without surface resistance) to a regime where surface resistance becomes important and begins to control the transport rate. It is also pointed out that the data may suffer from fluid mechanical acceleration effects and that they also suggest a condensation coefficient which decreases with time. (Novotny-Vanderbilt)
W70-04485

EXACT SOLUTION TO ENTRY-REGION LAMINAR HEAT TRANSFER WITH AXIAL CONDUCTION AND THE BOUNDARY CONDITION OF THE THIRD KIND,
Brookhaven National Lab., Upton, N.Y.
Hsu Chia-Jung.
Chemical Engineering Science, Vol. 23, p. 457-468, 1968. 4 tabs, 7 figs, 6 refs.

Descriptors: *Heat transfer, *Laminar flow, Mass transfer, Temperature, Viscosity, Reynolds number, *Mathematical models, Energy, *Heat flow, Diffusion, Bulk density, Specific heat, Velocity.

A mathematical scheme is devised for obtaining the exact thermal-entry-region temperature solutions for laminar flow (Poiseuille's parabolic velocity profiles) heat transfer subject to significant axial conduction and the boundary condition of the third kind. It is demonstrated that the heat transfer problem which ignores the effect of axial conduction, in reality, corresponds to a part of the generalized problem in which such effect is taken into consideration. Irrespective of the significance of axial conduction, the temperature solution can be represented by a unique mathematical expression in which only the magnitude of the eigenvalues and the associated constants vary with Peclet number. As Peclet number approaches infinity, the generalized temperature solution reduces to that for the case of negligible axial conduction. Determination of the first twelve eigenvalues, eigenfunctions and the series expansion coefficients was made with the aid of high-speed digital computer, for Peclet numbers of 1, 5, 10, 20, 30, 50, 100 and infinity, and for convective parameter delta (%kr sub zero/k) of 2, 10 and 100. Examination of the thermal-entry-region temperature profiles and the local Nusselt numbers revealed that the effect of axial conduction is indeed significant if Peclet number is less than approx. 100. The results of the present analysis showed good qualitative agreements with those of Schneider, who analyzed a similar problem by assuming a slug-flow model. (Novotny-Vanderbilt)
W70-04486

THE STABILITY OF BLOCKS SUBJECTED TO PLUNGING WATER JETS,
Windsor Univ. (Ontario).
S. P. Chee, and P. V. Padiyar.
Water Resour Bull, Vol 5, No 3, p 57-62, Sept, 1969. 6 p, 3 fig, 8 ref.

Descriptors: *Energy dissipation, Flip buckets, *Spillways, *Scour, Baffles, *Riprap, River beds, Streambeds, Jets, *Stilling basins, Model tests, Hydraulic models, Erosion, Hydraulics, Hydraulic structures, Foreign research.
Identifiers: *Energy dissipators, *Plunge basins, Foreign testing, *Armoring (Streambed), Ontario (Canada), Canada.

The energy of a jet of water from a spillway is commonly dissipated by using flip buckets to throw the jet a safe distance from the spillway. Model tests are often made to evaluate scouring in a homogeneous bed of granular material; the results always show a regular dish-shaped hole. The adverse performance of some prototype buckets has cast coubts on the wisdom of this design philosophy. Natural riverbeds are heterogeneous and develop very irregular steep-sided scour holes that may progress upstream and endanger the spillway. Secondary currents generated in the irregularly shaped scour hole break up and undermine the riverbed. Eliminating the secondary currents would protect the scour hole from further deterioration. This could be achieved by excavating a plunge pool and protecting the hole by armoring the bed with a layer of large boulders. Laboratory tests were made on the stability of cubical blocks subjected to plunging water jets. The blocks were placed in a plunge basin at the base of a flip bucket. A dimensionless equation was derived and a nomogram was drawn to facilitate the solution. The results can be applied in determining the size of stones required to armor a plunge basin or scour hole. (USBR)
W70-04540

8C. Hydraulic Machinery

WHAT ARE THE PROSPECTS FOR HV AND EHV UNDERGROUND TRANSMISSION SYSTEMS,
Sargent and Lundy, Chicago, Ill.
E. H. Finch.
Consult Eng, Vol 33, No 3, p 128-136, Sept 1969. 7 p, 5 tab, 3 ref.

Descriptors: *Transmission (Electrical), *Extra high voltage, Costs, Research and development, *Electric cables, *Underground, Technology, Transmission lines, Trenches, Comparative costs, Thermal properties, Dielectrics, Reliability, Failure (Power), Maintenance, Electrical equipment, Electrical design, Aesthetics, Economics, Electric insulation.
Identifiers: *High voltage, *Underground cables, Power losses, Federal Power Commission, Pipe-type cables, Dielectric properties, Outages.

A major technological breakthrough is necessary before ehv underground transmission systems can be justified economically. Although the cost differential is less for hv lines, the difference is still staggering compared to overhead lines. The solution may be to develop an entirely new type of underground system. Cost comparisons are given for underground versus overhead transmission systems for 138 kv and 345 kv. Technical problems presented in underground installations are discussed. Current research and details of several major research projects are reviewed. Placing ehv underground is discouraging from economic and technical factors inherent in today's designs, but the large volume of research is encouraging. A major breakthrough may be made because of the existing need.
W70-04136

ELECTRICAL STRESS IN OIL-FILLED AND SOLID-TYPE HIGH VOLTAGE DIRECT CURRENT CABLES UNDER THERMAL AND ELECTRICAL TRANSIENT CONDITIONS,
Sumitomo Electric Industries Ltd., Osaka (Japan).
K. Kojima, and K. Matsuura.

Direct Curr, Vol 1, No 2, p 55-72, Aug 1969. 18 p, 35 fig, 5 tab, 7 ref.

Descriptors: *Electric cables, *Direct current, Electrical studies, Stress, *Stress distribution, Electric insulation, *Transient stress, Electric potential, Resistivity, Temperature, Polarity, Instrumentation, Experimental data, Foreign research, Thermal stress, Time, Dielectrics, Electric currents, Electric fields.
Identifiers: *Oil-filled cables, Japan, *High voltage, Cable sheaths, Potential gradients, Temperature rise, Electric conductors, Test results.

Many complicated effects concerning the insulation design of paper-insulated, oil-filled and solid-type, high-voltage direct-current (hvdc) cables are clarified. The purpose is achieved by tests performed under different thermal and electrical transient conditions. Measuring potentials and stresses in the insulation in each case provided much information for the discussion on stress distributions in insulation at no-load conditions, at thermal transient conditions, and at rapid polarity reversal. In the cases of oil-filled cables, experimental results show fairly good agreement with theoretical distribution calculations, based on the characteristics of resistivity-temperature and stress observed on impregnated paper-insulated cables. The experimental arrangement for measuring potential distribution throughout the solid cable insulation is described. Results are given, and comparisons are made between measured values of potential distribution and theoretical values.
W70-04139

TOWER DESIGNS FOR AEP 765-KV PROJECT,
American Electric Power Service Corp., New York.
Richard A. Kravitz, and A. James Samuelson.
Proc Amer Soc Civ Eng, J Power Div, Vol 95, No PO2, p 305-319, Oct 1969. 15 p, 5 fig, 4 tab, 4 ref, 2 append.

Descriptors: *Structural design, Structural engineering, Transmission lines, *Transmission towers, *Extra high voltage, Spans, Loads (Forces), Winds, Guyed towers, Design, Overhead ground wire, Torsion, Foundations, Testing, Design criteria, Yield strength, Computer programs.
Identifiers: Tower height, *Test results, Allowable stress, Anchored footings, Comparative studies.

Designs of 765-kv transmission line towers used by the American Electric Power Co (AEP) are summarized. The weather loading conditions and line design criteria used in developing structure configuration and designs are described. Tower designers and engineers responsible for developing design specifications are alerted to the pitfalls of designing towers without considering all practical combinations (within a loading combination) of some minimum with maximum loads and unequal leg extension combinations in rough terrain. The AEP computer program for analyzing towers as 3-dimensional elastic structures is discussed and comparisons are made to hand (static) methods used for analyzing towers. Alternate types of foundations to be used are described, insofar as anchor movement affects structure capabilities.
W70-04265

DELAWARE RIVER BASIN COMPACT (WATERSHEDS, RECREATION, HYDROELECTRIC POWER, FINANCING, GENERAL PROVISIONS).
For primary bibliographic entry see Field 06B.
W70-04361

SOLAR BATTERIES AND AGROECONOMY OF DEVELOPING NATIONS,
Jadavpur Univ., Calcutta (India). Dept. of Electronics and Telecommunication Engineering.
For primary bibliographic entry see Field 03F.
W70-04413

8D. Soil Mechanics

STABILITY OF SLOPES WITH SEEPAGE,
Colorado State Univ., Fort Collins. Natural Resources Center.
C. D. Muir, and D. B. Simons.
Available from the Clearinghouse as PB-189 770, $3.00 in paper copy, $0.65 in michrofiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 30 p, 1 ref. OWRR Project A-002-COLO.

Descriptors: *Bank stability, *Slope stability, Seepage, Hydraulic design, Slip circle, Embankments.

The effect of steady seepage on slope stability was based on laboratory tests on embankments having slopes of 2 to 1, 3 to 1, 4 to 1, and 5 to 1, and including sections with gravel toe, coarse central layer, coarse layer parallel to the surface, fine cnetral layer, and alternating fine and coarse layers. Computed stability numbers gave an indication of the change in location of the failure zone, as well as giving the cohesion values required for slope stability for friction angles of 5, 10, and 20 degrees and for 0, 40, and 100 percent saturation above the phreatic surface. Graphic correlations in three variables are presented by plotting stability numbers and the pore pressure parameter, Ru sub ave. versus ratios of headwater and tailwater to embankment height. The possible contribution of tailwater to both surface and massive circular slope failures is clearly indicated. Also, an explanation of the shape of surface sloughing based on pore pressure distribution is presented.
W70-04052

OPTIMUM PRELOAD RATES FOR COMPRESSIBLE NORMALLY CONSOLIDATED SOILS,
Northwestern Univ., Evanston, Ill; and Howard Univ., Washington, D.C.
Raymond J. Krizek, Clarence H. C. James, and Jorj O. Osterberg.
Soils Found, Vol 9, No 3, p 58-81, Sept 1969. 24 p, 7 fig, 4 tab, 28 ref.

Descriptors: *Loading rate, Loading time, *Consolidation, Computer programs, Shear strength, Bibliographies, Bearing capacities, Numerical analysis, *Foundations, Soil engineering, Soil mechanics, Soil strength, Settlement (Structural), Theory, Soil properties, Pore pressure.
Identifiers: Optimum loading, *Compressible soils, *Compressible foundation, *Preloading.

The significance of shear strength increases on allowable preload rates for compressible, normally consolidated soils subjected to a flexible strip load is examined. On the basis of representative soil parameters and various assumed boundary conditions, a computer analysis was made to predict systematically rates and magnitudes of shear strength increases and associated settlements occurring as primary consolidation progresses, and to evaluate the bearing capacity of the soil in terms of the strength increases. With adequate drainage, weak soils may increase measurably in bearing capacity during consolidation in a time period compatible with many construction schedules. Inadequate drainage precludes any reasonable bearing capacity increase, except when the ratio of horizontal to vertical coefficient of consolidation is large. Consolidation settlement is governed by the magnitude and duration of the applied load, which is governed, in turn, by the rate of bearing capacity increase. Consolidation settlements can be accelerated to a worthwhile degree only when reasonable bearing capacity increases occur. Optimizing preload rate is of little benefit if initial soil strength is high. (USBR)
W70-04262

EFFECT OF WATER CONTENT ON THE SHEAR CHARACTERISTICS OF GRANULAR SOILS SUCH AS SHIRASU,
Kagoshima Univ. (Japan).
Motohisa Haruyama.
Soils Found, Vol 9, No 3, p 35-37, Sept 1969. 23 p, 18 fig, 3 photo, 1 tab, 22 ref.

Descriptors: *Moisture content, Effects, Shear strength, Granular materials, Shear tests, Characteristics, *Sands, Triaxial compression, *Triaxial shear, Cohesion, Internal friction, Void ratio, Stress-strain, Curves, Axial strain, Foreign research, *Soil mechanics, Bibliographies, Soil properties, Shear stress.
Identifiers: Water content, Triaxial tests, Drained tests, *Soil characteristics, Japan, Rowe equation.

The effect of water content on shearing characteristics of granular soils such as Shirasu (white volcanic sand) is examined by drained triaxial compression tests on compacted specimens having different water contents. Axial strain at failure and dilatancy decreases as the water content increases. Decrease in dilatancy causes decrease in critical void ratio. Parameters of shear strength vary with confining pressure; the frictional component is large at lower pressures and the cohesion component is large at higher pressures. Particle interlocking causes the failure envelopes to be curved and have a cohesion intercept. At relative densities above 70% and water contents below 10% the angle of shearing resistance does not vary with water content; at other densities and water contents, the angle of shearing resistance decreases as the water content increases. Apparent cohesion at all densities is highest at water contents of 10 to 20% and decreases considerably at water contents above 10 to 20%. Decrease in shear strength with increase in water content is caused by a decrease in the portion of strength contributed by particle interlocking.
W70-04263

MIXING-IN-PLACE SOIL AND PORTLAND CEMENT.

Proc Amer Soc Civ Eng, Soil Mech Found Div, Vol 95, No SM6, p 1357-1363, Nov 1969. 7 p, 12 ref, append.

Descriptors: Construction costs, Cement grouts, *Foundations, Portland cements, *Soil cement, *Soil stabilization, Underground structures, Soil mechanics, Costs, Piles (Foundations), Mixing.
Identifiers: Construction methods.

Practical methods can be developed for mixing natural soils in place with cement grout to obtain reasonably uniform and strong soil-cement concrete to depths of 50 to 75 ft at rates of 50 to 100 cu yd/hr and at a cost of about $10/cu yd. Mixing-in-place methods will have widespread application, particularly for constructing underground walls and masses of soil-cement concrete for structure foundations in earthquake regions. Uses of plastic soil-cement are discussed and methods of mixing soil and cement in place below the ground surface are summarized. (USBR)
W70-04530

SAND DENSIFICATION BY PILES AND VIBROFLOTATION,
Woodward-Clyde-Sherard and Associates, Oakland, Calif.; and Naval Facilities Engineering Command, San Bruno, Calif. Western Div.
Carl E. Basore, and Joseph D. Boitano.
Proc Amer Soc Civ Eng, J Soil Mech Found Div, Vol 95, No SM6, pp 1303-1323, Nov, 1969. 21 p, 22 fig, 1 tab, 7 ref, append.

Descriptors: Compaction tests, Compaction, Compaction equipment, Cohesionless soils, *Foundations, Field tests, Liquefaction, Sands, Penetration resistance, Penetration tests, Piles (Foundations), Soil engineering, Soil liquefaction, Soil mechanics, Test procedures, Loose soils, *Soil compaction.

Identifiers: Comparative studies, Construction methods, Procedures, *Vibroflotation, *Compaction piles, *Vibratory compaction.

The effectiveness of compaction piles and vibroflotation in densifying 30 ft of loose to medium-dense sandfill at Treasure Island, Calif, was evaluated by field tests. Compaction piles were formed by driving a 14-in.-dia steel pipe mandrel with a false bottom to the required depth, filling the pipe with sand, and then withdrawing the pipe to leave a sand column. Relative densities of the fill were measured before and after densification by standard penetration tests and with samples obtained using a piston sampler. Compaction piles and vibroflotation were effective in densigying the sandfill when proper spacing was used. Vibroflotation produced a more uniformly dense fill. Compaction piles were spaced closer together than vibroflot points to produce the same relative density. Limited cost data indicate that vibroflotation is more economical than compaction by piles. (USBR)
W70-04533

A FLEXIBLE PROGRAM FOR AUTOMATIC ANALYSIS OF STABILITY OF SLOPES,
Mozambique Univ., Lourenco Marques; and Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
J. B. Martins, E. Maranha, and F. A. Melo.
Eng Geol, Vol 3, No 3, p 249-261, July, 1969. 13 p, 6 fig, 3 tab, 10 ref.

Descriptors: *Computer programs, *Slip-circle method, Soil mechanics, *Slope stability, Soil engineering, Soil strength, *Stability analysis, Safety factors, Pore pressure, Earth dams, Embankments, Equations, Flow diagrams, Fills, Earthworks, Soil stability, Foreign design practices.
Identifiers: Computer-aided design, Bishop method of slices, Piezometric surface, Portugal.

A computer program for stability analysis of slopes (land slopes, earth dams, embankments, and quay walls) by the Swedish slip-circle method is described. Safety factor equations and a flow chart are presented. Two factors of safety are computed, one according to the ratio of resisting to overturning moments, the other based on a reduction factor of the strength of the soil, bringing the soil mass to a limiting equilibrium. Pore pressures can be defined either by Skempton's pore pressure coefficient taken as characteristic of each soil or by a piezometric polygonal line. Limited only by the capacity of the computer, 14 different soils separated by polygonal lines having a maximum of 50 vortices can be included in the soil mass, and the material above the failure surface can be divided into a maximum of 100 slices. Results from stability analyses of 2 specific cases are given. (USBR)
W70-04538

8E. Rock Mechanics and Geology

ROCKBOLTING OF TUNNELS FOR STRUCTURAL SUPPORT, PART I --THEORETICAL ANALYSIS, PART II--DESIGN OF ROCKBOLT SYSTEMS,
California Univ., Berkeley; and Leeds, Hill and Jewett, Inc., San Francisco, Calif.
H. D. McNiven, and H. M. Ewoldsen.
Int J Rock Mech Mining Sci, Vol 6, No 5, p 465-497, Sept 1969. 32 p, 19 fig, 11 ref.

Descriptors: *Rock bolts, Rock mechanics, Rock properties, *Tunnels, Tunnel design, Compression, Displacements, Elastic theory, Numerical analysis, Slipping, Strain, Stress analysis, Stress distribution, Supports, Tension, Tensile stress, Theory, Tangential stress, *Theoretical analysis.
Identifiers: Rock pressures, *Tunnel supports, Compressive stress, Computer-aided design, Slip planes, Tectonic loads.

Theoretical analysis of stresses and preliminary rational design procedures for rock bolt systems in tunnels are presented for several idealized cases. Stress fields for a circular tunnel in a gravitating medium and the stress field created by a single rock bolt are developed. Computations are made to obtain typical stress fields and to demonstrate the influence of the historic state of stress on the stress field surrounding the tunnel. The tunnel is examined for tension, compression, and slip failures; designs of rock bolt systems to prevent failure are presented. (USBR)
W70-04142

SYSTEMATIC MAPPING OF FRACTURE MORPHOLOGY,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
R. J. Lutton.
Geol Soc Amer Bull, Vol 80, No 10, p 2061-2065, Oct 1969. 5 p, 4 fig, 8 ref.

Descriptors: *Fractures, *Fractures (Geology), Materials, Symbols, Rocks, Rock properties, Shear cracks, Tension, Cohesive soils, Cracks, *Morphology, Loads (Forces), Surfaces, Mapping, *Geologic mapping, *Geologic investigations, Brittle failures, Ductility, Fissures, Joints (Geology), Fissures (Geology), Cracking.
Identifiers: Fracture traces, Crack propagation, Rock breakage.

The morphological approach to the study of rock fractures has been neglected until recently, and still is not fully appreciated. This is caused partly by the general failure to recognize that similar features can be found on fractures over a great range of scales. The relatively simple and universal fracture morphology is shown in a great range of scales, material types, and loads. The characteristic fracture forms are incorporated into a system of mapping symbols that apply equally well for all nonshear fracture surfaces in a variety of materials. Fractures can be described graphically in this manner regardless of type of material and loading condition over a scale range of 7 or more orders of magnitude. Observations made at the submicroscopic, microscopic, megascopic, and perhaps larger scales could be interrelated in different fields of physical science. (USBR)
W70-04143

8F. Concrete

MIXING-IN-PLACE SOIL AND PORTLAND CEMENT.
For primary bibliographic entry see Field 08D.
W70-04530

CONCRETE REPAIR PROBLEMS: CAUSES AND CURES.

Concr Constr, Vol 14, No 11, pp 409-427, Nov, 1969. 16 p, 19 photo, 2 tab, 25 ref.

Descriptors: Concrete construction, Concrete structures, *Concrete technology, *Concretes, *Repairing, *Maintenance, *Rehabilitation, Deterioration, Alkali-aggregate reaction, Cracking, Cavitation, Crazing, Dusting, Efflorescence, Scaling, Stains, Sealing compounds, Protective coatings, Bibliographics.
Identifiers: *Concrete deterioration, Concrete properties, Concrete pavements, Concrete products, Crack control, Spalling.

For good results in repairing concrete, the causes of the deterioration must be determined. Sometimes the cause is readily apparent, but more frequently a skilled specialist or laboratory examination may be required. Some common causes of deterioration include alkali-aggregate reaction, cavitation, cracking, crazing, dusting, efflorescence, pop-outs, sandstreaking, scaling, spalling, stains, and uneven color. Recommended repair techniques include acid etching, calking, coating, replacement of concrete, dry-packing, grinding, jacketing, slab-jacking, resurfacing, sandblasting, stitching, and stressing. Some basic information is given on selecting repair materials. A veritable arsenal of repair materials and techniques is available for dealing with every type of deterioration. Concrete structures have the unique distinction of rarely being beyond repair. (USBR)
W70-04532

8G. Materials

ELASTOMER TECHNOLOGY,
Firestone Tire and Rubber Co., Akron, Ohio.
Fred C. Weissert.
Ind Eng Chem, Vol 61, No 8, p 53-59, Aug 1969. 7 p, 116 ref.

Descriptors: *Elastomers, *Rubber, Molecular structure, Additives, Fillers, Elastic deformation, Elasticity (Mechanical), Bibliographies, Reviews, *Synthetic rubber, Polymers, Physical properties, Mechanical properties, Tires, Curing compounds, Sealing compounds, Adhesives, Materials engineering, *Chemical engineering, Research and development.
Identifiers: Polymerization, Viscoelasticity.

Continued improvement in the performance of elastomer products requires further knowledge of the relationships between molecular structure and mechanical behavior of elastomeric compounds. During 1968, research investigations emphasized the macromolecular features such as molecular weight distribution, branching, and crosslinking. A second growing area of elastomer research is directed toward understanding the nature of the physical and chemical interaction between phases of polymer blends, and also between rubber and filler phases. The presence of 2 or more phases is generally essential in useful elastomeric products. Current developments in polymer elastomers and blends are discussed; recent research and development work on additive compounding ingredients is reviewed, including mechanical behavior of polymers and compounding ingredients, and testing for characterizing the variety of intended end use conditions.
W70-04131

ADHESIVES, 1969,
PPG Industries, Inc., Springdale, Pa.
C. Clement Anderson.
Ind Eng Chem, Vol 61, No 8, p 48-52, Aug 1969. 5 p, 5 fig, 8 tab, 41 ref.

Descriptors: *Adhesion, *Adhesives, Materials, Materials engineering, *Polymers, Interfaces, *Wettability, Wetting, Composite materials, Surface tension, Reviews, Bibliographics, *Bonding, Rubber, Elastomers, Epoxy resins, Curing.
Identifiers: Bonding agents, Bond strength, Polyurethane resins, Peeling, *Synthetic resins.

Progress in the development of synthetic polymer adhesives is reviewed, covering new bonding processes, pressure-sensitive adhesives, rubber-based adhesives, carboxylated adhesives, polyurethanes, new methods of analysis, and important aspects of adhesion such as wetting, contact angle, and other interfacial phenomena. An empirical relationship has been established between glass temperature and critical surface tension of a polymer. Studies on the wetting of surfaces by polymer melts show that the cosine of the contact angle attains its final value apparently according to second-order kinetics. The wettability and conformations of reactive polysiloxanes were investigated; a table gives the critical surface tensions. Studies of the interface in glass-epoxy composites showed that fracture occurred at the glass-resin interface when adhesion was poor, but deep within the resin matrix when adhesion was good; good adhesion was observed when a coupling agent capable of co-reacting with the epoxy resin and forming a covalent bond was used.

W70-04132

STAINLESS STEELS AND OTHER FERROUS ALLOYS,
Hercules, Inc., Wilmington, Del.
Hugh B. Fischer.
Ind Eng Chem, Vol 61, No 8, p 42-47, Aug 1969. 6 p, 192 ref.

Descriptors: *Steel, Steel plates, Steel pipes, *Stainless steel, Structural steel, Pressure vessels, *Welding, Specifications, Alloys, Manufacturing, Heat exchangers, Boilers, Materials, Reviews, Materials engineering, Bibliographies.
Identifiers: Steel tubing, Stress corrosion, *Alloy steels, Corrosion resistance, *Corrosion resistant alloys, Electron-beam welding.

Materials selection, corrosion resistance, new alloys, new manufacturing techniques, and welding are covered in a review on ferrous materials. The review will enable selecting materials and maintenance for satisfactory operation under corrosive conditions and under extreme temperature and pressure. Materials for heat exchangers, piping, boilers, and pressure vessels are included. References are given on corrosion resistance, specific corrosion data, and stress corrosion cracking. Developments of new alloys in the U.S. and elsewhere are reported, including an austenitic stainless steel resistant to stress corrosion cracking in sea water, new structural steels, and a series of new superplastic stainless steels. The present trend in welding is toward increased deposition rates and decreased heat output. Large-diameter pipelines have been routinely welded with a portable electron-beam welder.
W70-04133

PLASTICS CHEMISTRY AND ENGINEERING,
Houston Univ., Tex.
Raymond B. Seymour.
Ind Eng Chem, Vol 61, No 8, p 28-41, Aug 1969. 14 p, 1 tab, 712 ref.

Descriptors: *Plastics, *Polymers, *Materials engineering, *Chemical engineering, Industrial production, Building materials, Containers, Education, Reviews, Bibliographies, Structural members, Membranes, Sheeting, Composite materials, Foams, Plastic pipes, Synthetic fibers, Weathering, Aging (Physical), Durability.
Identifiers: Synthetic resins, Careers, Plastic foam, Corrosion resistance.

The annual growth rate of the synthetic polymer industry in the USA is almost 3 times the average for all other industries; the volume of polymer production is projected to exceed the volume of all other non-polymer materials by 1980. Uses for synthetic polymers are being found to replace conventional materials in packaging, building materials, automobiles, aircraft, and road paving. Developments in applications of plastics are reviewed for structural materials, containers and vessels, composite materials, sheets and film, foams, plastic pipe, and synthetic fibers. The weathering, durability, corrosion resistance, and flame resistance of polymers are discussed; characterization and testing are included. The phenomenal growth of the polymer industry may be retarded in the early 1970's because of the scarcity of polymer-oriented scientists and engineers. Education and career opportunities in polymer science and technology are discussed.
W70-04135

POLYMER COATINGS,
PPG Industries, Inc., Springdale, Pa.
N. H. Frick, H. L. Gerhart, and H. E. Gilbert.
Ind Eng Chem, Vol 61, No 8, p 60-75, Aug 1969. 16 p, 3 fig, 2 photo, 263 ref.

Descriptors: *Protective coatings, *Paints, *Polymers, Reviews, Test procedures, Bibliographies, Resins, Pigments, Formulation, Curing, Color, Characteristics, Physical properties, Weathering, Emulsions, Mildews, Materials engineering.
Identifiers: Polymerization, *Plastic coatings, Synthetic resins, Latex.

An annual review of developments in polymer coating technology is presented to indicate some new directions taken and to create an awareness of problems and solutions. The review is not a rote recitation of all the coatings literature published in the past years. Emphasis is given to the concepts having useful application and information of current concern on breakthrough research that gives greater insight. Not all segments of technological effort in polymer coatings are reported, and coverage of application technology is limited. Subjects discussed are formulation concepts, synthetic resins, high energy activation, performance and testing, characterization techniques, physical properties, weathering, pigments and color science, and mildew control.
W70-04137

OVERVOLTAGES APPEARING ON HVDC CABLES DUE TO CONVERTER OPERATION,
English Electric Co. Ltd., Stafford; and Allmanna Svenska Elektriska A.B., Ludvika.
J. D. Ainsworth, Arne Johanssen, and K. J. Ralls.
Direct Curr, Vol 1, No 2, p 83-88, Aug 1969. 6 p, 11 fig, 2 ref.

Descriptors: *Direct current, *Electric cables, Disturbances, Faults (Electrical), Converters (Electrical), Transmission (Electrical), Transients, Lightning, Transmission lines, *Conductors, Inverters, Rectifiers, Alternating current, Foreign research.
Identifiers: *Overvoltage, *High voltage, Switching surges, Induced voltage, Protection (Electrical), Lightning surges.

Overvoltages experienced in hvdc conductor systems are caused by: (1) malfunctioning of either valves, or valve firing, or control circuits; (2) faults occurring in the d-c system; (3) disturbances in the a-c system propagating through into the d-c system; (4) external sources, such as lightning striking d-c overhead lines; and (5) normal control operations such as blocking, deblocking, and starting transmission. The effects of these 5 types of disturbances are discussed, principally those caused by faults originating in the d-c converters and d-c lines, or from the a-c systems. The information given is for consideration of d-c cables only; numerical examples are for illustration because the actual values of overvoltages depend on the configuration of individual schemes.
W70-04140

09. MANPOWER, GRANTS AND FACILITIES

9D. Grants, Contracts, and Research Act Allotments

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Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-04045

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